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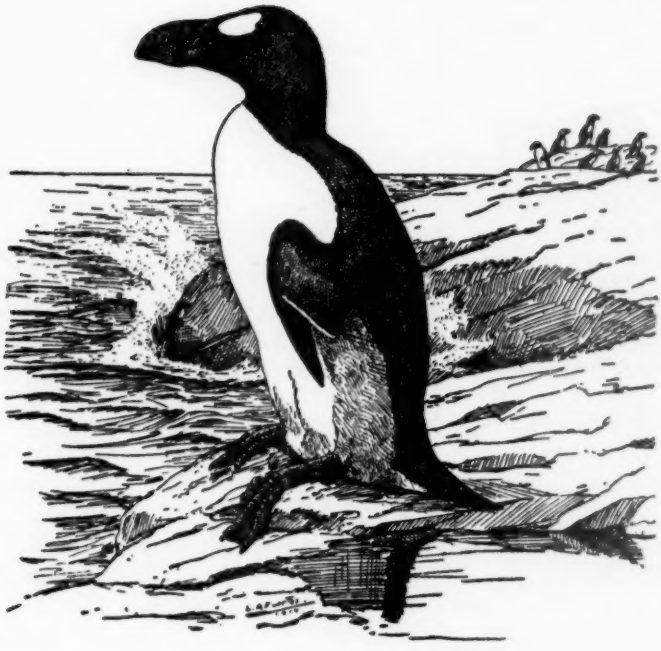

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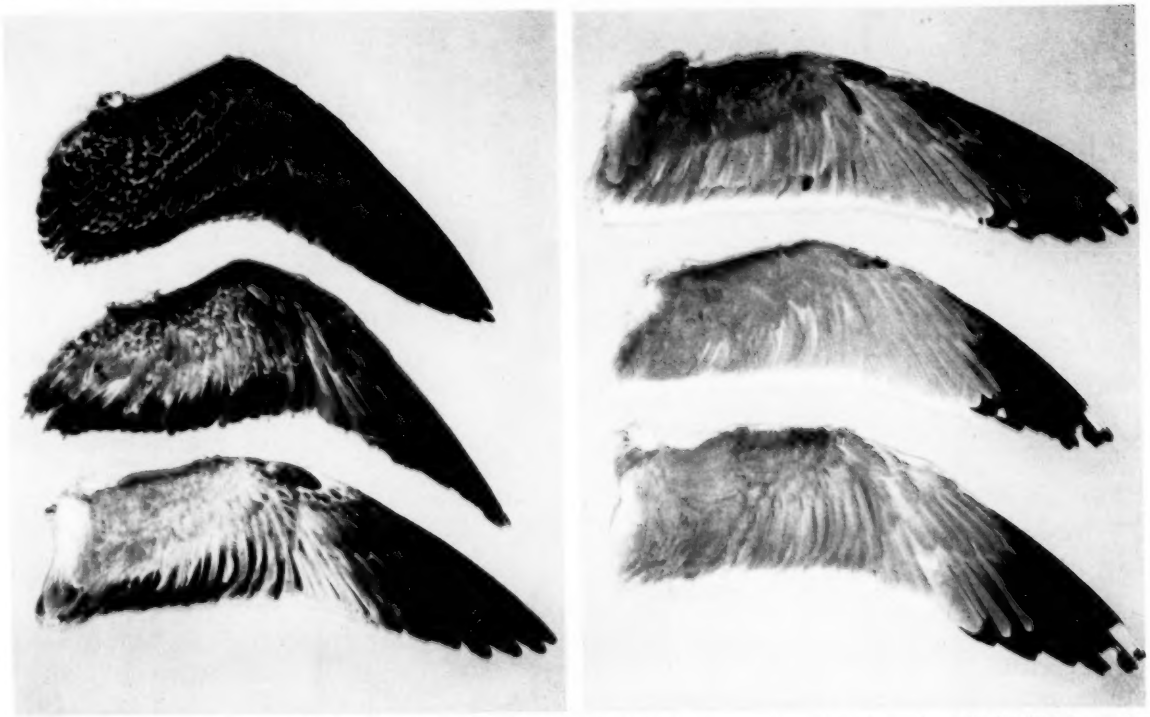

Wings of California Gulls. (*Left*) Juvenal (*top*); first nuptial (*middle*); second nuptial (*bottom*). (*Right*) Third nuptial (*top*); four-year-old (adult) (*middle*); adult (*bottom*).

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THE PLUMAGE CYCLE OF THE CALIFORNIA GULL (*LARUS CALIFORNICUS*) WITH NOTES ON COLOR CHANGES OF SOFT PARTS

BY WILLIAM H. BEHLE AND ROBERT K. SELANDER

THE standard reference for the sequence of molts and description of plumages of gulls is the work of Dwight in which he attributed (1925: 197) to the California Gull (*Larus californicus*) a four-year plumage cycle whereby the adult non-nuptial or winter plumage is attained in the fall of the third year, and the full adult nuptial plumage is obtained in March and April of the third year, just prior to the time (May) when the bird reaches four years of age (see Dwight, *op. cit.*: 92–96, for terminology of cycles). Brooks (1943) reviewed the cycle of the California Gull in connection with a discussion of the relationship of the species with the Herring Gull (*Larus argentatus*) and the Ring-billed Gull (*Larus delawarensis*) and attempted to show that the California Gull has a two year cycle to maturity (a three-year plumage cycle) with the adult non-nuptial or winter plumage being attained in the fall of the second year, and the adult nuptial plumage being acquired in the following spring shortly before the bird becomes three years old. The principal point of disagreement pertains to the later plumage stages from the third year on, Brooks not recognizing as a regular stage the immature third-year plumage described by Dwight.

The extensive banding of California Gulls in the region of Great Salt Lake (see Woodbury, Behle, and Sugden, 1946; Woodbury and Knight, 1951; and Behle and Woodbury, 1952) developed the possibility of clearing up this discrepancy and extending our knowledge of the cycle of the species with specimens of known age. Poor (1946: 136), in connection with a similar study of the Herring Gull, pointed out the desirability of systematic collecting of banded birds to solve such ornithological problems. Accordingly, during the seasons of 1950, 1951, and 1952, frequent collecting trips were made to the Farmington Bay colonies in Davis County, Utah, where 9300 gulls had been

banded between 1944 and 1949. We succeeded in collecting banded gulls of several ages as follows: ten two-year-old birds, ten three-year old birds, two four-year-old birds, two six-year-olds, and one each of eight and ten years, respectively. In addition, we obtained 138 unbanded birds of various ages, including three that represent the one-year-old condition. Data concerning body weight, size, coloration of plumage and soft parts, and condition of reproductive organs were recorded in the field. Most of the banded birds were prepared as conventional study skins. The tail and one wing of the unbanded birds were saved as flattened preparations. In addition to material collected for this study, we have examined several specimens of immature birds in California museums. We gratefully acknowledge the help of many students and associates, particularly Howard Behle, John Bushman, Norman Chamberlain, Clark Johnson, and Richard Porter. David W. Johnston examined two early versions of the manuscript and offered several valuable suggestions which were helpful in preparation of the final draft.

This paper presents a summary of the sequence of molts and plumages and a description of the plumages themselves and the associated coloration of the soft parts, based primarily on the banded birds. With the characters for the various ages established by birds of known age, we determined the probable age of the unbanded birds and present the data on these also. To avoid confusion, we have employed the terminology of Dwight who used "nuptial" in referring to plumages assumed during the breeding season regardless of the bird's reproductive capacity. Incidentally, Dwight (1901) outlined the order of renewal of feathers in the process of molt for the Laridae, and Beck (1942: 100) has described the sequence of areas molted by the California Gull from natal to juvenal plumage.

Downy Young

Plumage features.—Upon hatching about mid-May, the young gulls have a fluffy covering of whitish natal down feathers. Some specimens show a faint buffy band across the chest and buff under the eye. A few blotches of black appear on the throat and flanks. On the dorsal surface, there are scattered black or dark brown blotches resulting in a mottled or dusky effect, which presumably affords some measure of concealing coloration. The spots on the head are blacker and more sharply defined than those on the back, which are browner and less distinct. Inconspicuous dark spots also appear on the facial region, namely on the lores, chin, and around the eyes. The natal down is worn two or three weeks, being gradually replaced in a com-

plete post-natal molt by the juvenal plumage. This transition occurs for most individuals in late May and early June, so that by mid-June the majority of young are in full juvenal plumage.

Color of soft parts.—The legs and feet are dark brown or blackish during the downy young stage. The eyelids are of similar color with the iris a lighter brown. The bill is black except for the terminal third which is creamy white or flesh colored; the gape pink or flesh colored; the calcified egg tooth near the tip of the maxilla is white. Prominent in the early stages, the egg tooth is gradually resorbed. With the progress of the post-natal molt, there is diminution of the light color at the tip of the bill, which continues until the bill is almost uniformly black in the early juvenal stage.

JUVENAL PLUMAGE

Plumage features.—The young gulls are dusky brown in this plumage, the feathers of the back being brown or cinnamon brown with conspicuous edgings of creamy white or pale buff. The undersurface is also mottled, since the feathers there are white at the base with the terminal third characterized by a series of wavy cross bars consisting in sequence of a wide gray-brown bar, narrow white one, wide gray-brown one, and, finally, a narrow outer margin of white or gray. The remiges are dull black, without spots or mirrors, a bit lighter on the inner webs, and with a very narrow margin of white at the tip (plate 6). The tail is almost uniformly dark brown (plate 7).

The juvenal California Gulls that we have studied show much more white on the dorsum than the specimen presented by Brooks (1943) in his figure 1, plate 2. By September, wear of the white tippings of both the flight and contour feathers has produced a darker bird than a juvenile in late July or August. The juvenal body plumage is replaced by a post-juvenal molt, presumably starting in September and lasting several months. The remiges, rectrices, and tail coverts are retained.

Color of soft parts.—In the early juvenal stage, the bill is uniformly black except for the extreme tip which is creamy white, but with growth of the bird and increase in size of the bill, the basal portion, especially of the lower mandible, becomes lighter. This change is apparent by late July or August. This leaves the terminal half black in contrast to the light base. The feet are dark brown or black in the early juvenal stages, gradually becoming lighter in late July and August. The iris remains brown; the eyelids still blackish; the gape remains flesh color or pink.

TABLE 1

SUMMARY OF PLUMAGE FEATURES OF THE CALIFORNIA GULL

Plumage	*Juvenal*	*First-winter*	*First-nuptial*	*Second-winter*
How acquired	Complete post-natal molt	Partial post-juvenal molt	Partial pre-nuptial molt	Complete post-nuptial molt
Time of molt	Late May-June	September-January	February-May	June-August
Primaries	Black	Blackish brown	Faded to brown	Black with faint basal tongues of gray
Tail	Black edged with white	Blackish brown	Faded to brown	Variable: most with basal half white, terminal half black
Tail coverts	Barred or mottled brown and white	Whiter with less barring	Some white, others barred	White
Mantle	Brown with whitish edgings	Dusky gray splotched with brown	Dull blue-gray with more or less dark blotches	Light and clear blue-gray
Head and neck	Brown with white edgings	Mottled brown and white	White with dusky markings	White with few dusky markings
Throat and breast	Mottled gray and white	Mottled but whiter	White with few dusky markings	White with few dusky markings
Belly	Mottled gray and white	White but still mottled and dusky	Mottled and dusky	Mostly white, some dusky
Alula, primary and secondary coverts	Black	Blackish brown	Faded to brown	Variable: dusky brown or gray
Markings near tips of 9th and 10th, or outermost, primaries	Black with no spots or mirrors	Black with no spots or mirrors	Black with no spots or mirrors	Variable: 9th brown; 10th all brown, or with faint or distinct mirror
Inner 4 primaries	Gray-black	Blackish brown	Faded to brown	Whitish brown; lighter than other primaries

TABLE 1—(*Continued*)

Second-nuptial	*Third-winter*	*Third-nuptial*	*Fourth-winter (adult)*	*Fourth-nuptial (adult)*
Partial pre-nuptial molt	Complete post-nuptial molt	Partial pre-nuptial molt	Complete post-nuptial molt	Partial pre-nuptial molt
February-April	May-August	February-April	June-August	March-April
Black with faint basal tongues of gray at base	Distinct gray tongues	Distinct gray tongues	Distinct gray tongues	Distinct gray tongues
Variable: most with basal half white, terminal half black	Variable: typically mostly white, black near tip	Variable: typically mostly white, black near tip	White	White
White	White	White	White	White
Light and clear blue-gray	Light and clear blue-gray	Light and clear blue-gray	Light and clear blue-gray	Light and clear blue-gray
White with few dusky markings or heavily mottled	White, possibly faint markings	White, occasionally with dusky markings	White streaked with brownish-gray	Pure white
White with few dusky markings	White with few dusky markings	White with few dusky markings	White	White
Mostly white, occasionally some dusky	White	White	White	White
Variable: dusky brown or gray	Variable: blue-gray smudged with brown	Variable: brown, blue-gray, or gray smudged with brown	Gray; often sparsely smudged with dusky	Gray; often sparsely smudged with dusky
Variable: 9th brown; 10th all brown, or with either faint or distinct mirror	Variable: 9th either all brown or with faint mirror; 10th with either faint or distinct mirror	Variable: 9th either all brown or with faint mirror; 10th with either faint or distinct mirror	Variable: 10th with distinct mirror; 9th either all brown or with faint or distinct mirror	Variable: 10th with distinct mirror; 9th either all brown, or with faint or distinct mirror
Whitish brown; lighter than other primaries	Gray as in adults	Gray	Gray	Gray

CHANGES DURING THE FIRST WINTER

Dwight (1925: 198) considered birds in the first winter to represent a distinct plumage, characterized by the "back [being] paler and grayer than the juvenal, and with less mottling, and the barring of a paler brown, more fused and diluted." His reference specimen was taken November 11. Brooks (*op. cit.*: 17) presents in his figure 2, plate 2, a ten-month-old gull (which we have examined), taken April 26, which is in first nuptial plumage and has a decidedly grayish mantle. Beck (1943: 58) stated that "Dwight's description is of a bird at the beginning stages of [the first] winter plumage while Brooks' description is for the terminus of [the first] winter plumage." According to Beck (*op. cit.*), who reared California Gulls from the downy stage, there is a gradual month to month replacement of the body feathers through the first winter as though there were one protracted molt. It seems to us that two molts of the body plumage occur, the post-juvenal and the first pre-nuptial. By January, near the conclusion of the post-juvenal molt, the incoming feathers of the underparts are partly white, resulting in a generally lighter appearance. The juvenal mantle feathers are replaced with dusky-grayish feathers which are variously splotched with brown. Some specimens show replacement of certain of the juvenal marginal coverts of the wing, but many individuals show no replacement of wing coverts during the winter. By early May, the feathers have again been replaced in the first pre-nuptial molt, and the first nuptial plumage is assumed. Throughout both of these molts, the juvenal remiges, rectrices, and apparently many of the tail coverts are retained.

FIRST NUPTIAL PLUMAGE

Plumage features.—The back is now almost continuously blue-gray with only a few dark blotches remaining. The blue-gray is duller than that of subsequent plumages, and there is considerable individual variation in the degree of blue-grayness of the mantle achieved during the winter molts. Two of our one-year-old examples taken May 23 and June 20 do not have their mantles as uniformly blue-gray as does Brooks' specimen illustrated in his figure 2, plate 2, which was taken April 25. The head, nape, and rump areas, although somewhat mottled, are essentially white. The underparts are whitish, although some mottling remains, especially on the belly. The old juvenal rectrices and remiges are now faded to brown and are abraded in greater or lesser degree. The wing coverts (juvenal) are also faded to light brown and frayed (plate 6). Essentially, this is the bird described by Brooks and shown in his figure 2 of plate 2. This is the first nuptial plumage of Dwight.

TABLE 2

SUMMARY OF USUAL OR "TYPICAL" COLORS OF SOFT PARTS FOR DIFFERENT AGE GROUPS OF CALIFORNIA GULLS

Character	*Downy Young*	*Juvenal*	*First Nuptial*	*Second Nuptial*	*Third Nuptial*	*Adult Nuptial*
Gape	Pink or flesh color	Pink or flesh color	Creamy white	Cream, pink, or pale orange	Orange or orange-red	Orange-red
Eyelids	Black	Black	Black	Slightly orange or pale red	Orange-red or red	Orange-red or red
Iris	Brown	Brown	Brown	Brown	Brown	Brown
Pupil	Blue	Blue	Blue	Blue	Blue	Blue
Red spot on lower mandible	Not present	Not present	Not present	Pale to intermediate red	Pale to deep red	Extensive; orange-red
Black band in front of red spot	Not present	Not present	Very wide on both maxilla and mandible	Varies from 11 to 2 mm. in width and forms prominent subterminal band	Reduced, but varies from 10 mm. to 0	Inconspicuous or absent
Bill	Black except for terminal third which is cream or flesh color	Initially black except tip which is creamy white; basal portion becomes lighter	Creamy white except for broad subterminal black band	Varies from cream or gray to greenish yellow or yellow	Greenish yellow or bright yellow	Bright yellow
Legs and feet	Blackish brown or black	Initially blackish brown, becoming gradually lighter	Bluish, gray, or creamy white	Varies from cream to pale green to yellow	Green or yellow	Green, pale yellow, or deep yellow

Color of soft parts.—The bill is now a creamy white except at the tip, where there is a broad subterminal black band on both maxilla and mandible. The iris is brown; the eyelids black; the gape creamy white. The feet are variable in color, being either bluish, gray, or creamy white.

Gonads.—The gonads of our three one-year-old birds in first nuptial plumage are relatively small as compared with birds in second, third, and subsequent nuptial plumages, the left testis measuring 3 x 2 (May 23), 4 x 1 (June 20), and 4.5 x 2 mm. (May 23), respectively. Perhaps the lack of development of the gonads is correlated with poor development of the migratory instinct, since the small sample obtained suggests that most first year birds do not return to the natal region.

SECOND WINTER OR NON-NUPTIAL PLUMAGE

One specimen taken June 20 shows the beginning of the first post-nuptial molt, which involves complete replacement of the plumage. The inner four primaries and their coverts are just coming in; the outer three of the four are of approximately equal length and the innermost is only a little ahead of the others in development. The median upper secondary coverts are new and ensheathed, being about 25 mm. long. Scattered new feathers are coming in on the mantle, neck, breast, and belly, and both the upper and lower tail coverts are being replaced. As noted by Dwight, the new rectrices tend to be squarer at the tips than the more rounded juvenal ones. The new flight feathers are blackish in color on the upper surface but paler gray below. The inner four primaries are lighter than the others. The tail feathers, although essentially black, are more whitish at the base than are those of the juvenile and again are narrowly margined with white. The underparts and head are now essentially white except on the belly, sides of the throat, and eye region, where there is some dusky. The hind neck is still dusky and blotched. The back is essentially blue-gray and comparable in shade to the fully adult condition. The wing coverts are mostly mottled with gray and brown. The alula feathers are blackish brown.

SECOND NUPTIAL PLUMAGE

Plumage features.—The second winter or non-nuptial plumage seemingly is retained with little change except for wear and some further replacement of body feathers during the second pre-nuptial molt. There is much individual variation with respect to the head markings in the second nuptial plumage. The head is white in some birds, although most individuals still have some dusky markings on

the occipital region, so that the appearance varies from white with just a few scattered blotches to dark and heavily mottled. There also is some variability in color of the wing coverts. Most specimens show some gray median upper secondary coverts in the area closest to the body. These are probably attained during the winter in the post-nuptial molt (see plate 6). Some specimens still show dusky feathers on the center of the belly.

TABLE 3

VARIATION IN COLOR OF FEET AND LEGS OF CALIFORNIA GULLS REPRESENTING SEVERAL AGE GROUPS. NUMBERS REFER TO THE NUMBER OF INDIVIDUALS IN THE SAMPLE POSSESSING THE COLOR CHARACTER INDICATED

	1st Nuptial		*2nd Nuptial*		*3rd Nuptial*		*4th Nuptial*	
	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀
Cream or flesh color	1	0	2	3	2	1	0	1
Blue	1	0	5	0	1	0	0	0
Blue-gray	0	0	4	2	0	0	1	0
Gray	1	0	6	2	2	1	1	0
Gray-green	0	0	3	0	4	0	0	0
Green	0	0	8	6	14	1	6	8
Green-yellow	0	0	4	2	2	1	2	0
Yellow	0	0	0	2	8	0	4	8
Total Individuals	3	0	32	17	33	4	14	17

With reference to the white markings on the outermost primary, of 7 banded specimens in this two-year age category, 4 lack white and 3 have a distinct marking similar to that shown in Dwight's figure 111 (page 355). Of 51 unbanded specimens of this age, 8 have a prominent white mark on the outermost primary, 14 have an indistinct mark, and 29 lack white markings. As to the tail pattern, 7 banded specimens have markings essentially as portrayed by Dwight in figure 112 (page 355), except that two have some all-white feathers. Of the 51 unbanded birds, 36 have tails similar to that shown by Dwight in figure 112, while 9 have considerably less black in the tail, especially at the base (see plate 7). The other 6 are variously intermediate. Thus, the darker condition with the basal portion white and the distal half dark brown or black may be regarded as typical. The other conditions appear, therefore, to be instances of individual variation. Furthermore, there is some variability with respect to the coloring of the individual tail feathers. In the tails of 2 banded and 6 unbanded specimens, one or more of the rectrices is pure white (see plate 7).

Color of soft parts.—The feet and legs are exceedingly variable, ranging through eight colors from cream or flesh to yellow, as indicated in table 3. The green type is predominant. The bill likewise shows considerable individual variation, ranging from cream to gray or yellow, there being about as many cream as yellow. The gape is

either cream, pink, or pale orange. The eyelids are pale orange or pale red. The red spot near the tip of the lower mandible varies from slightly to moderately prominent, mostly the latter. The subterminal black band of the bill is, in most specimens, so prominent that it resembles the condition in the Ring-billed Gull. Actually, it is subject to great individual variation, the width ranging from 2 to 11 mm

TABLE 4

MEASUREMENTS OF CALIFORNIA GULLS OF KNOWN AGE
FARMINGTON BAY COLONIES, DAVIS COUNTY, UTAH

		Males		*Females*	
Character	*Age Group*	*Number of specimens*	*Mean and extremes*	*Number of specimens*	*Measurements*
Weight	2nd nuptial	4	653 (648–794)	1	642
(Grams)	3rd nuptial	7	660 (600–710)	0	—
	Adult	4	725 (675–820)	1	616
Wing	2nd nuptial	6	379.6(360–395)	1	373
(Chord)	3rd nuptial	9	394.2(370–415)	0	—
(Millimeters)	Adult	4	387.2(370–400)	1	365
Tail	2nd nuptial	6	145.0(138–152)	1	143
	3rd nuptial	9	147.6(140–160)	0	—
	Adult	4	150.7(149–152)	1	144
Tarsus	2nd nuptial	6	58.1(55–62)	1	53
	3rd nuptial	9	58.8(56–62)	0	—
	Adult	4	57.0(53–60)	1	56
Exposed	2nd nuptial	6	47.1(46–48)	1	50
Culmen	3rd nuptial	9	46.8(43–49)	0	—
	Adult	4	47.2(46–48)	1	42
Depth of	2nd nuptial	6	16.0(15–18)	1	16.0
bill at base	3rd nuptial	8	16.2(15–18)	0	—
	Adult	4	17.2(16–18)	1	14.5

Condition of gonads.—Although two-year-old birds are presumably not breeding, their gonads are considerably larger than those of birds in first nuptial plumage and, furthermore, seem to show swelling and shrinking as in the adult cycle. The data that suggest this are presented in tables 6 and 7. The swollen condition was evident by the time our earliest sample was taken on May 8. Based on the length of the left testis of males, indications are that the swelling reached a peak during the third week in May and started to diminish in June. The trend is less pronounced in females, whose largest ova ranged around 3 and 4 millimeters in May. Yet the sample of June 20–21 showed some reduction. The oviduct was not swollen in any of the two-year old females.

TABLE 5

MEASUREMENTS OF UNBANDED CALIFORNIA GULLS OF SEVERAL AGE GROUPS
FARMINGTON BAY COLONIES, DAVIS COUNTY, UTAH

		Males			*Females*		
Character	*Age group*	*Number of specimens*	*Range*	*Mean with standard error**	*Number of specimens*	*Range*	*Mean with standard error*
Weight (Grams)	First nuptial	3	575–750	662	0	—	—
	Second nuptial	33	500–775	659±9	17	500–636	567±11
	Third nuptial	33	600–775	671±9	4	525–650	591
	Adult nuptial	15	550–748	653±15	17	425–625	526±11
Wing (Chord) (Millimeters)	First nuptial	3	345–395	375.6	0	—	—
	Second nuptial	33	340–420	389.6±3.0	17	355–390	373.5±2.8
	Third nuptial	33	340–430	392.5±2.4	4	360–385	369.2
	Adult nuptial	15	375–420	398.1±3.1	16	359–400	383.4±2.5
Tail	First nuptial	3	126–145	138.3	0	—	—
	Second nuptial	33	140–158	147.9±0.8	17	132–147	139.9±1.3
	Third nuptial	33	138–160	149.6±0.4	4	138–148	145.0
	Adult nuptial	15	146–159	152.0±1.0	17	135–147	142.2±0.9
Tarsus	First nuptial	3	53–67	60.1	0	—	—
	Second nuptial	33	55–62	58.2±0.3	16	51–58	54.0±0.8
	Third nuptial	33	47–63	58.0±0.5	4	51–53	52.0
	Adult nuptial	15	55–67	59.0±0.8	16	49–62	54.3±0.8
Exposed Culmen	First nuptial	3	41–46	43.3	0	—	—
	Second nuptial	33	43–50	46.6±0.2	17	39–47	42.2±0.5
	Third nuptial	33	43–50	47.0±0.3	4	42–44	43.0
	Adult nuptial	15	45–54	48.6±0.7	17	40–48	44.2±0.6
Depth of bill at base	First nuptial	3	12–15	14.1	0	—	—
	Second nuptial	33	15–18	16.5±0.2	17	13–18	14.8±0.3
	Third nuptial	32	14–20	17.3±0.2	4	14–16	15.0
	Adult nuptial	14	15–19	17.1±0.3	17	14–18	15.7±0.3

* The Standard error of the mean $= \frac{\sigma}{\sqrt{n}}$ where $\sigma = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$.

THIRD WINTER OR NON-NUPTIAL PLUMAGE

According to both Dwight and Brooks, when California Gulls are a little over two years old, there occurs in late summer (July and August) the second complete molt. Our specimens show that, in the Great Salt Lake area, molt of the primaries begins by the last week in May. By June 20, the inner 5 or 6 primaries are new and about one-half grown, and the median secondary coverts and scapulars have been replaced. This molt leads to a third winter or non-nuptial plumage which becomes the third nuptial plumage by a partial pre-nuptial molt in March and April. This plumage is similar to that of the adult but is characterized by having the primary coverts and alula smudged with dusky and the tail largely white with a few irregular smudges.

According to Brooks (1943: 17), the first adult plumage is assumed following the second complete molt when the bird is a little over two

years old. He denied the regular occurrence of Dwight's third year plumage, believing that specimens so characterized are "backward individuals," not representative of the normal sequence. Although we have no specimens of birds in the third winter or non-nuptial plumage, we do have several banded specimens of a known age of three years, which demonstrate the existence of a distinctive third year plumage as described by Dwight.

TABLE 6

DEGREE OF DEVELOPMENT OF GONADS OF CALIFORNIA GULLS OF KNOWN AGE
(Measurements in millimeters)

	Length of Left Testis								
	Second Nuptial Plumage			*Third Nuptial Plumage*			*Adult Nuptial Plumage*		
Date	*Number of specimens*	*Range*	*Mean*	*Number of specimens*	*Range*	*Mean*	*Number of specimens*	*Range*	*Mean*
May 8	0	—	—	1	18.0	18.0	0	—	—
May 10–12	4	15.0–7.0	10.7	4	14.0–11.0	12.5	2	12.0–10.0	11.0
May 18	0	—	—	0	—	—	0	—	—
May 23	2	9.5–4.5	7.0	4	19.5–15.0	18.2	0	—	—
June 1	0	—	—	0	—	—	1	12.0	12.0
June 20–21	0	—	—	1	8.0	8–0	1	12.0	12.0
	Largest Ovum								
May 8	0	—	—	0	—	—	0	—	—
May 10–12	1	3.0	3.0	0	—	—	1	4.0	4.0
May 18	0	—	—	0	—	—	0	—	—
May 23	1	5.5	5.5	0	—	—	0	—	—
June 1	0	—	—	0	—	—	0	—	—
June 20–21	0	—	—	0	—	—	0	—	—

THIRD NUPTIAL PLUMAGE

Plumage features.—The mantle and wing coverts are predominantly blue-gray except for some dusky mottling on the alula and primary coverts (plate 6). The amount of dusky marking on the wing coverts is highly variable and is most prevalent or abundant in those specimens having very dark tails. The head, nape, rump, and underparts are pure white with some brownish spotting on the sides of the throat and breast. Dwight showed two tail patterns for gulls in this plumage (1925: figures 114 and 116, page 356). Two of our banded specimens show considerably more black than either of those shown by Dwight and, in this regard, are not distinguishable from birds in the second nuptial or two-year-old condition. Both of these birds had smaller testes than birds having less black on the tail and, hence, were probably retarded individuals. A third specimen lacks a definite tail band, having, instead, half of the rectrices predominantly black and half pure white. The remaining banded specimens have tails

TABLE 7

DEGREE OF DEVELOPMENT OF GONADS OF UNBANDED CALIFORNIA GULLS
(Measurements in millimeters)

	Length of Left Testis											
	First nuptial plumage			*Second nuptial plumage*			*Third nuptial plumage*			*Adult nuptial plumage*		
Date	*Number of specimens*	*Range*	*Mean*	*Number of specimens*	*Range*	*Mean*	*Number of specimens*	*Range*	*Mean*	*Number of specimens*	*Range*	*Mean*
May 8	0	—	—	7	16.5–5.5	11.6	3	19.4–17.3	18.0	3	23.0–19.0	20.4
May 10–12	0	—	—	6	15.0–7.0	10.3	9	22.0–12.0	16.5	3	12.0–10.0	11.0
May 18	0	—	—	2	15.0–11.0	13.0	7	18.0–9.0	14.5	1	15.0	15.0
May 23	2	4.5–3.0	3.7	4	16.0–14.0	15.6	5	20.0–9.0	12.8	2	15.0–14.0	14.5
June 1	0	—	—	6	13.0–9.0	10.5	3	17.0–11.0	14.0	3	9.0–6.0	7.6
June 20–21	1	4.0	4.0	9	12.0–5.0	7.6	3	12.0–6.0	8.3	4	10.0–7.0	8.2
	Largest Ovum											
May 8	0	—	—	3	4.0–3.0	3.3	1	4.0	4.0	0	—	—
May 10–12	0	—	—	5	4.0–2.5	3.3	3	15.0–3.0	7.6	1	10.0	10.0
May 18	0	—	—	0	—	—	0	—	—	0	—	—
May 23	0	—	—	3	4.0–3.0	3.3	0	—	—	9	6.0–3.0	4.6
June 1	0	—	—	0	—	—	0	—	—	0	—	—
June 20–21	0	—	—	6	2.0–1.0	1.8	0	—	—	7	4.0–2.0	2.4

with the irregular black markings confined near the tips of the rectrices (see plate 7). Of our 38 unbanded birds of this age, 6 have tails as dark as or darker than that shown in Dwight's figure 114, and 32 have tails more comparable to his figure 116. Thus, it appears that the typical condition as regards black in the tail is that of having the tail mostly white with irregular subterminal smudges (plate 7).

As pertains to the markings of the outer primaries of three-year old birds in the third nuptial plumage, Dwight figured two situations (figures 113 and 115, pages 355–356). Of the 10 banded birds we have in this age category, one has markings similar to his figure 113, showing no white near the tip of the ninth primary (numbered from the inner to the outer). The others are either like the condition portrayed in his figure 115 or intermediate between the two conditions. Of the 38 unbanded birds which we judge to be of this age, 10 have wing markings similar to his figure 113, while 27 are similar to figure 115. One specimen has no white on the outer two primaries. Thus, the condition shown in figure 115 is the more common.

From this discussion it will be noted that gulls in the third nuptial plumage have many of the features of adult plumage, the most obvious differences being the possession of a black subterminal part of the tail and smudging on the alula and primary coverts. Since it is this third nuptial plumage which Brooks failed to recognize, it may be well to point out in some detail the distinctions between it and both the second nuptial and adult nuptial plumages. As compared with birds in second nuptial plumage, most three-year-old birds have the head and neck generally white instead of blotched with light brown, although some individuals may still have the head lightly specked. The dusky markings on the bend of the wing and wing coverts are greatly reduced, although a few may persist. This feature is highly variable. The primaries of some birds appear to be blacker. The gray tongues on the primaries are as well defined as in the adults. Furthermore, the inner four primaries are gray as in the adults. This is perhaps the best means of discriminating between California Gulls in third nuptial as opposed to second nuptial plumage, for these inner four primaries in the second year birds are light brown (see plate 6). (Even our most retarded three-year-old birds with black tails and much dusky in the body plumage have the inner four primaries gray rather than light brown.) The tail is spotted with black or dusky. The bill is yellower with the red spot more prominent. The black band at the terminal part of the bill is reduced in many specimens, more particularly on the maxilla.

In their third nuptial plumage, California Gulls resemble birds in the adult nuptial plumage in having the head and underparts white and the mantle a clear blue-gray. The bill is bright yellow, but the red spot is not as fully developed as in the adult. The terminal portion of the tail of third year birds is black in greater or lesser degree as opposed to the pure white tail of adults. The primary coverts, alula, and greater secondary coverts of the three-year-old birds are marked with dusky, while those of the adult are, with few exceptions, immaculate. A difference sometimes exists in the secondaries. In most third year individuals these feathers are as in the adult, being gray except for the relatively wide terminal band of white, but some birds in the third nuptial plumage have some or all of the secondaries dusky on the outer half of the vane except for a narrow white terminal margin.

Color of soft parts.—Three-year-old birds in third nuptial plumage show great individual variation in color of soft parts. Seven color types of the legs and feet are represented (see table 3), with the majority of individuals having green legs and feet; but yellow is also common. Most individuals have yellow bills, with a few tending toward green-yellow or orange-yellow. The gape is either orange or red, as are the eyelids. The red spot on the lower mandible tends to be more prominent than in two-year-olds but not as conspicuous as in adults. In a few instances it is only moderately developed, thus resembling the normal condition for birds a year younger. The subterminal black band of the mandibles is reduced in most individuals as compared with the typical two-year-old condition. However, some birds resemble two-year-old birds in this character, while in others the black is virtually absent, thus showing the typical adult condition. The black band ranges from 1 to 10 millimeters in width.

Condition of gonads.—The gonads of individuals of this age group are, on the average, larger than those of birds in second nuptial plumage. The same pattern of recrudescence and subsequent waning as the season progresses is shown (see tables 6 and 7). Maximum size is seen in the small sample of May 8. There are some indications of breeding, as will be discussed in the following section.

BREEDING STATUS OF GULLS IN THIRD NUPTIAL PLUMAGE

If California Gulls breed during their third spring and summer, the third nuptial plumage is the first true nuptial plumage. While the evidence is not conclusive, there are indications that at least some of the gulls in the Great Salt Lake region breed in their third year. Woodbury, Behle, and Sugden (1946: 12) noted two instances of color

banded gulls three years of age supposedly nesting. One, banded at Egg Island, was seen to settle down on a nest with eggs at one of the Farmington Bay colonies. The second, banded at Rock Island, Utah Lake, was seen there along with many other gulls in the nesting colony. To this we add the following evidence. Ten additional banded three-year-old birds and many more judged to be three years old on the basis of plumage characters and colors of soft parts, were taken by us on the islands at Farmington Bay where colonies of gulls nest. They did not differ in behavior from the fully adult individuals with which they were associated. The gonads of these three-year-old birds were swollen, being nearly as large as those of adults. In one female a 15 mm. ovum and a swollen oviduct were found. Richard D. Porter observed a gull with three-year-old plumage features settle down on a nest with eggs at the Ogden Bay Refuge, Weber County, on May 23, 1952.

Fourth Winter or Non-nuptial Plumage (Adult)

Following the third nuptial plumage there is, according to Dwight (1925: 201), a complete post-nuptial molt in August, September, and October leading to a fourth winter or non-nuptial (adult) plumage. Our material indicates that this molt commences considerably earlier in the Great Salt Lake birds, namely in late June and early July. During this molt, the black of the tail, which is diagnostic of three-year-old birds, apparently is lost, and the tail becomes pure white, presumably thereafter remaining so. The rump and underparts are pure white. The mantle and wing coverts are clear blue-gray. The head now becomes streaked with brownish gray. Thus, the gulls have assumed the adult non-breeding dress three years after the juvenal plumage, when they are slightly more than three years old.

The sequence of molts and plumages is finally rounded out by a partial pre-nuptial molt in March and April (just prior to the beginning of the fourth year) which leads to the fourth or adult nuptial plumage. They presumably breed this spring for the first time, if indeed they did not do so the previous spring.

Fourth Nuptial Plumage (Adult)

Plumage features.—We have been able to secure only two banded four-year-old birds. These are like the true adults in having pure white tails and immaculate plumage, but the coverts of the outer three primaries and alula are dusky, and one bird has a splotch of dusky on two of the secondaries of either wing (plate 6). According to

(*Left*) Tails of California Gulls (coverts removed). *Top:* Juvenal (which is retained in first nuptial plumage). *Second row:* Variation in second nuptial plumage. *Third row:* Variation in third nuptial plumage. *Bottom:* adult.

(*Right*) Bills of California Gulls. *Top to bottom:* first nuptial, second nuptial, third nuptial, adult nuptial. Note progressive reduction of black in terminal portion.

Dwight (*loc. cit.*), the primary coverts of birds in fourth winter and fourth nuptial plumage are uniformly gray like the mantle. However, limited dusky markings on the primary coverts and alula are present on our eight-year-old specimen, and our ten-year-old specimen has several dusky markings on the primary coverts. It should be noted that both of the banded four-year-old birds have much more dusky on the primary coverts and alula than do the eight- or ten-year-old birds. It would appear, therefore, that at least in some individuals all the dusky markings of the plumage are not lost by the end of four years as Dwight's statements lead one to believe. This is also suggested by some unbanded material.

In our collecting we obtained eight unbanded specimens which we have been unable to place satisfactorily in an age category. All of these specimens have slight smudging on the tail, sometimes as little as a single spot 10 mm. in diameter. Some have immaculate wings (but *with* smudging on the tail), while others have light smudges on the alula or a few of the primary coverts. It would seem that these could be advanced three-year-olds, or four-year-olds, or individual variants of ages greater than four years. However, all five of our banded birds four years or older have pure white tails. Poor (1946: 145) found that not all specimens of the Herring Gull in the fourth winter and fourth nuptial plumages (which Dwight considered to be adult) had pure white tails. In Poor's data, six four-year-old birds had tails chiefly white with dark areas covering one-third or less of the exposed rectrices, compared to nine individuals with pure white tails.

Considerable individual variation exists among adult California Gulls as to the white markings on the outer two primaries. Dwight (1925: 201) reported that "Birds in completely adult dress usually have two mirrors, the outer primary often with a wholly white tip or a large mirror crossed by a narrow black line. There is much variation, some few birds having a mirror only on the outer. The type of the species (A.M.N.H., No. 46070; California), which I have examined, is such a bird and doubtless a fall female. The outer primary is not fully grown and the head and neck are streaked. It is, unfortunately, not a typical specimen, as most adults have either two mirrors, or more often the outer primary has a long white tip. This specimen (Fig. 117) has but one mirror."

As pertains to our specimens, of the six banded birds four years or older, five are like his figure 120, wherein the tip of the outer (tenth) primary is extensively white and the ninth primary is white at the tip with a black band below followed by a prominent subapical white spot. One is more like his figure 119 which was presumably meant to show a

dull or poorly developed mirror on the ninth primary. Of the 32 unbanded adults, 12 are most nearly like his figure 120. Six are more like his figure 119. Four of our examples conform to Dwight's figure 117, in which there is no mirror on the ninth primary. Ten others have the outermost primary as in his figure 117, but the adjacent primary as in figure 119, a combination not illustrated by Dwight. Thus, it appears that Dwight's figure 120 illustrates the commonest condition.

Since the foregoing was written, David W. Johnston has collected a banded female in fourth winter plumage which has the tail feathers splotched with numerous pale dusky markings. This specimen was banded at Farmington Bay, Davis County, Utah, on June 4, 1949, and was collected at the Albany Dump, Alameda County, California, on January 30, 1953.

Color of soft parts.—The color of the legs and feet of adults is either green or yellow (see table 3) except for an occasional one that is flesh color. There is less variability than for the two previous years. The gape is red or orange; the eyelids mostly red, but occasionally orange. The bill is mostly a bright yellow or a brilliant orange-yellow. The red spot is more extensive than in any previous year, being a vivid orange-red and, in some individuals, extending to the upper mandible. The black of the bill continues to be variable. It may be either absent, in the form of a slight blotch within the red, or a noticeable band that varies from 2 to 6.2 mm. in width.

Condition of gonads.—As far as our dates of collection are concerned, maximum size of the testes of males was noted at the time of our first sample on May 8. This was apparently past the peak of the egg-laying period. Beck (1942: 97) reported gulls copulating at Rock Island, Utah Lake, on April 11. He also found the first eggs for the season on April 11 in 1941 and on April 12 in 1942. The peak of egg-laying was around May 1. This corresponds with our observations at Farmington Bay. The earliest date we have for hatching is May 5. The data in table 7 show a gradual diminution in size of the gonads through late May and June. (Incidentally, in many individuals the right testis is smaller than the left.) Fewer data are available for females, but the same trend is indicated.

MOLTS AND PLUMAGES OF ADULTS

It appears that there is in the adult a normal sequence of two molts per year, the annual complete summer-fall molt leading to a dark-headed winter plumage, and a mid-winter or early spring partial molt at which time the head loses the dusky and becomes white for the

breeding season. A seasonal change takes place in the coloration of the soft parts, the colors becoming intensified for the breeding season. This is especially true of the red spot and the yellow of the bill.

SEX RATIOS

Random sampling of California Gulls in the several nuptial plumages revealed some significant differences in sex ratios between pre-adult and adult stages. Only three individuals representing the first nuptial plumage were taken, and all were males. Of 60 birds in second nuptial plumage, 41 were males and 19 females. Of 47 in third nuptial plumage, 43 were males and only 4 were females. In contrast, the adults showed an approximate 50–50 ratio, there being 19 males and 18 females.

The great majority of birds were shot from the air above the nesting sites. In the immature groups representing the second year, the differences can not be attributed to females incubating, and it is doubtful that this explanation would hold for the birds in third nuptial plumage. It would seem that the immature males have a greater attraction to the nesting sites than females of similar age. Whether the immature females are in the region but not at the nesting colonies is not known.

SEXUAL VARIATION

There do not seem to be any differences between the sexes in color characters. This holds true from the downy young to the adult stage. There are, however, several significant size differences between males and females as shown in tables 4 and 5, the males being larger than females. We did not obtain juveniles or females in first nuptial plumage, but the size differences are present from the two-year stage on.

THE RELATIONSHIP OF THE CALIFORNIA GULL AND THE HERRING GULL

Some systematists (see synonymy in Hellmayr and Conover, 1948: 266) have regarded *Larus californicus* as being conspecific with *Larus argentatus*. Brooks (*op. cit.*) protested this treatment on the basis of characters of voice, color of soft parts, and age of maturing. He concluded that *Larus californicus* is a distinct species with affinities as close to the Ring-billed Gull (*Larus delawarensis*) and other species of the green-footed gulls, as to the *Larus argentatus* group. Be that as it may, our findings refute Brooks' argument based on time of maturing. There is close similarity in sequence of molts and plumages

between *Larus californicus* and *Larus argentatus*, and not the differences supposed by Brooks. The two species do not agree in all particulars, however, as a comparison of our table 1 with table 3 of Poor (*op. cit.:* 144) will show. Perhaps the most significant difference is that the Herring Gull, as pointed out by Poor (*op. cit.:* 141), has no gray feathers in the mantle in the first nuptial plumage. In contrast, blue-gray feathers appear in the mantle of the California Gull during the first winter, and a rather uniformly blue-gray mantle is assumed for the first nuptial plumage.

SUMMARY

New data furnished by 26 banded birds of known age and 138 unbanded birds taken on their nesting grounds corroborate the findings of Dwight that the California Gull has a three-year cycle to maturity [a four-year plumage cycle] rather than a two-year cycle as suggested by Brooks.

Despite the occurrence of considerable individual variation in speed of molt and details of plumages, with few exceptions distinctions can be made between gulls in spring and fall for the three years normally required to attain full adult status. Following the speckled whitish natal down stage, there is a distinctive dusky brown juvenal stage in which dress the gulls leave the Great Salt Lake region in late summer and fall.

There is a change from month to month through the first winter as a result of two closely following molts, the post-juvenal and first pre-nuptial, both of which involve the body plumage only. These lead to the first nuptial plumage characterized by a dull blue-gray back and whitish, but mottled, head, neck, and underparts. The wing and tail feathers, which are the old juvenal ones, become faded and frayed.

In summer and fall, a complete molt occurs leading to a second-winter or non-nuptial plumage. A subsequent spring partial pre-nuptial molt establishes the second nuptial plumage, in which the tail is white at the base and broadly banded with black at the tip.

In their third summer and fall the birds undergo a second complete molt and acquire a third winter or non-nuptial plumage. Another spring partial molt results in the third nuptial plumage in which the body is essentially immaculate as in adults, but the wing and tail still show dusky markings in greater or lesser degree.

During the fourth fall there is again a complete molt leading to the adult condition in the fourth winter or non-nuptial plumage. This is followed in the spring by a partial pre-nuptial molt resulting in the adult nuptial plumage. However, there is evidence that the duskiness

is not completely lost on the primary coverts and alula until some time after the fourth year. Banded birds, four, eight, and ten years old, showed slight dusky markings on the wing coverts.

Adults have a complete post-nuptial molt acquiring a dusky-headed fall-winter plumage. The head becomes pure white for the breeding season by a partial pre-nuptial molt.

A series of color changes in legs, feet, bill, and gape accompany the plumage changes of the aging process. Considerable individual variation is manifest in these characters from the first spring on. The colors of the soft parts, particularly the bill, become accentuated during the breeding season. The subterminal black markings gradually diminish.

The California Gull has a molt sequence that is similar in general features to that of the Herring Gull (*Larus argentatus*). One notable difference, however, is the acquisition of a blue-gray mantle by the California Gull during the first year, whereas the Herring Gull has a brown mantle during the first year.

It is not known whether California Gulls regularly breed during the third spring and summer, but the gonads of many individuals have reached full adult size by then, and indications are that some individuals do breed.

There does not seem to be any sexual variation in plumage characters or coloration of the soft parts, but there are size differences, males being larger than females at least from the two-year stage on.

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NESTING OF THE KING RAIL IN THE ARKANSAS RICE FIELDS

BY BROOKE MEANLEY

In view of the paucity of life history information concerning the King Rail (*Rallus elegans*), the writer undertook to obtain additional data on this species in the Grand Prairie region of the Arkansas rice belt during the nesting seasons of 1950, 1951, and 1952.

The Grand Prairie represents the heart of a long narrow rice belt that extends from the Louisiana to the Missouri line and lies in the eastern part of the state of Arkansas. The Grand Prairie surrounds the city of Stuttgart and is roughly bounded on the north by U. S. Highway 70; on the south, by the Arkansas River; on the east, by the White River; and on the west, by Bayou Meto. It is a former natural tall-grass prairie and has become the leading rice producing area in Arkansas. Approximately one-fourth of its 650,000 acres of cultivated land is planted to rice annually, with oats, soybeans, and lespedeza as alternate crops in the rotation system.

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Much information was obtained about the King Rail in the course of banding nestling Red-wings (*Agelaius phoeniceus*) along drainage ditches, rice field canals, and areas of slash. Observations and collection of a few rail specimens were possible at other seasons as the writer was in the field for an average of ten hours daily throughout a two-year period. Six nests were located while driving along a highway at about 20 miles per hour some two to five miles north of Stuttgart. Other nests were found by systematically covering certain rice fields and by walking ditches in likely nesting habitats. Several nests were located by employees of the University of Arkansas Rice Branch Experiment Station when "roguing" rice fields for coffee bean (*Sesbania macrocarpa*) and indigo (*Aeschynomene virginica*) in mid- and late summer, as well as in their work about experimental rice plots.

The "mud hen," "slash guinea," or "English rail," as the King Rail is known to the rice grower, is a common breeding bird through-

out the rice belt, and finds an optimum habitat in the rice fields. From the time watering begins in early summer until harvest in midfall these fields provide nesting, feeding, and escape cover; in winter the rice stubble and aquatic vegetation resulting from rice field irrigation continue to fulfill most ecological requirements.

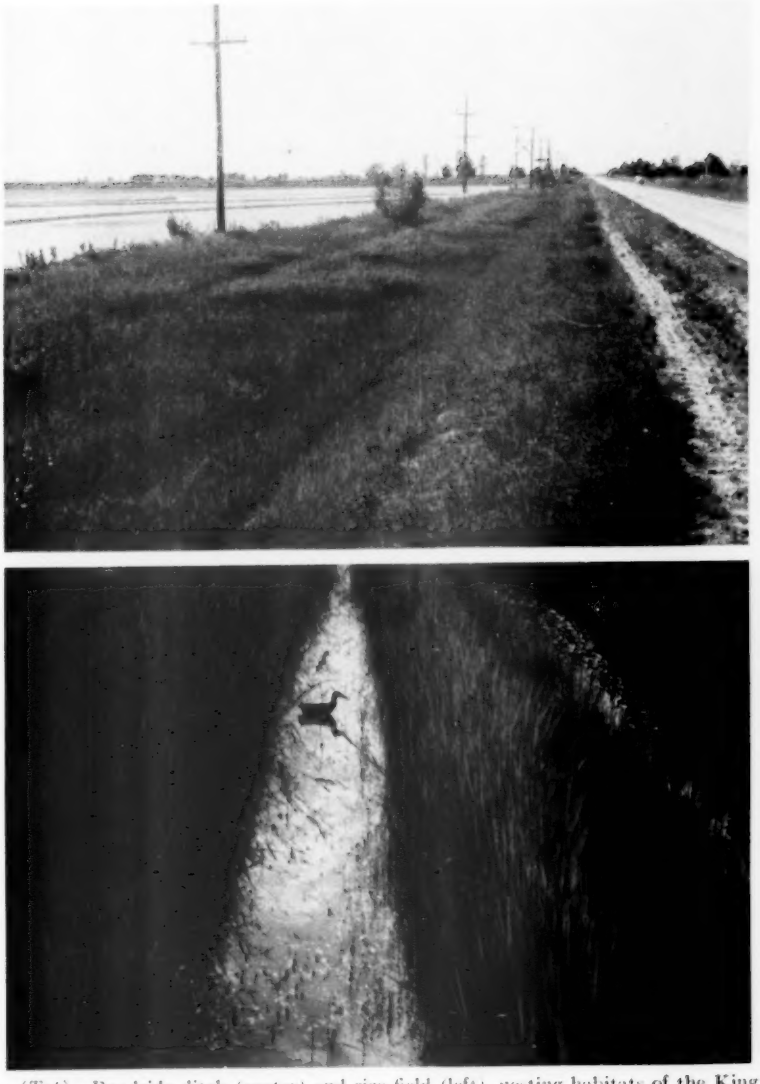
The King Rail is less numerous here in winter than in the warmer months, but there are a number of records of occurrence for every month of the year. Little is known about the migration of the breeding population, and I have received only one return on a banded bird. On June 7, 1952, I banded a chick, approximately 10 days old, five miles south of Stuttgart. This bird was recovered on December 1, 1952, at Cut Off, Lafourche Parish, Louisiana (about 25 miles south of New Orleans).

NESTING PERIOD

The nesting season extends from early March until early September, with the peak of activity occurring between April 15 and July 1. Data for 38 nests are presented in table 1. The earliest indication of breeding at Stuttgart is a pair of King Rails observed copulating along a roadside ditch on March 3 (1952). Also during the month of March, 1952, nearly all King Rails seen were in pairs. A nest containing one egg was found on April 1, 1952; and a dead female found on the road north of Stuttgart on April 3 contained in its oviduct a partly developed egg measuring 18 millimeters in length. Latest evidence of nesting is September 7 (1951), which is the date of the last visit to a nest containing 9 eggs (nest 38).

HABITAT AND POPULATION

In the spring nests are built mainly in roadside ditches, canals, canal banks, oat fields, and fallow land. Flash flooding in the narrow ditches, predation, harvesting of oat fields, and cultivation destroys many nests and newly hatched young. While many rails nest in the cultivated rice fields during June, July, and August, it is probable that these represent second nesting attempts following the destruction of the first clutch. Nearly all of the nests located in April were situated either in small old-growth stands of common cat-tail (*Typha latifolia*) or in nearly pure stands of a sedge (*Carex hyalinolepis*), while in May and June most of the nests were found in uniform stands of soft rush (*Juncus effusus*). Most of the earlier nests located in roadside ditches were found in ditches along main highways; these ditches were wider than those along the secondary roads and contained a more extensive and advanced growth of aquatic vegetation than that found in sur-



(*Top*) Roadside ditch (center) and rice field (left), nesting habitats of the King Rail 10 miles north of Stuttgart, Arkansas.

(*Bottom*) King Rail approaching nest in rice field. Stuttgart, Arkansas, July 13, 1952.

(*Top*) King Rail nest in roadside ditch near Stuttgart, Arkansas, May 30, 1952.

(*Bottom*) Incubating King Rail on nest made of cat-tails in roadside ditch.

TABLE 1

NESTING DATES, CLUTCH SIZE, AND HABITAT OF KING RAIL NESTS

Nest Number	*Date Nest Found*	*Number Eggs*	*Complete Clutch Size*	*Number Hatched*	*Location*	*Dominant Vegetation*
1	April 1, 1952	1	11	8	Ditch	*Typha latifolia*
2	April 10, 1952	b	2d	..	Canal	*Juncus* sp.
3	April 15, 1952	4	12	12	Ditch	*Typha latifolia*
4	April 16, 1952	11	11	9	Ditch	grass?
5	April 21, 1952	10	10	9	Ditch	*Juncus effusus*
6	April 21, 1952	14	14	14	Ditch	*Carex hyalinolepis*
7	April 24, 1952	4	4d	—	Ditch	*Carex hyalinolepis*
8	May 1, 1952	1	1d	—	Ditch	sedge?
9	May 1, 1952	11	11	11	Ditch	*Typha latifolia*
10	May 2, 1952	new	d	—	Ditch	*Juncus effusus*
11	May 2, 1952	11	11	10	Ditch	sedge?
12	May 6, 1952	5	11	9	Ditch	*Juncus effusus*
13	May 9, 1950	4	5d	—	Rice Field	*Oryza sativa*
14	May 9, 1951	6	11	—	Ditch	*Juncus effusus*
15	May 10, 1948	12	12	—	Oat Field	*Avena* (var.)
16	May 10, 1952	9	9	9	Ditch	*Juncus effusus*
17	May 10, 1952	11	11	10	Canal Bank	*Bromus secalinus*
18	May 11, 1952	12	12	10	Ditch	*Juncus effusus*
19	May 13, 1952	10	10	0	Ditch	*Juncus effusus*
20	May 26, 1952	2	2d	—	Canal Bank	grass?
21	May 28, 1952	4	8	8	Ditch	*Juncus effusus*
22	June 4, 1952	eb	—	—	Weedy Field	grass? & sedge?
23	June 9, 1952	10	10	10	Canal Bank	*Avena* (var.)
24	June 13, 1952	7	—	—	Rice Field	*Oryza sativa*
25	June 13, 1952	eb	—	—	Pond Edge	*Paspalum distichum*
26	June 13, 1952	eb	—	—	Pond Edge	*Paspalum distichum*
27	June 19, 1952	9	9	—	Rice Field	*Oryza sativa*
28	June 25, 1952	10	10	—	Rice Field	*Oryza sativa*
29	July 15, 1950	—	—	—	Rice Field	*Oryza sativa*
30	July 15, 1950	—	—	—	Rice Field	*Oryza sativa*
31	July 15, 1950	—	—	—	Rice Field	*Oryza sativa*
32	July 15, 1950	—	—	—	Rice Field	*Oryza sativa*
33	July 15, 1950	—	—	—	Rice Field	*Oryza sativa*
34	July 18, 1951	7	9	—	Rice Field	*Oryza sativa*
35	August 1, 1950	6	8d	—	Rice Field	*Oryza sativa*
36	August 9, 1951	5	5d	—	Rice Field	*Oryza sativa*
37	August 10, 1951	6	6d	—	Rice Field	*Oryza sativa*
38	August 29, 1951	9	9	—	Ditch	*Echinochloa* sp.

d—deserted b—building eb—eggs broken

rounding areas. Nests found in rice fields during the summer were located in pure stands of rice (*Oryza sativa*), or in weedy rice fields containing barnyard grass (*Echinochloa*) or sedges (*Cyperus strigosus* and *Fimbristylis autumnalis*). The shift to the rice field habitat during the presumed renesting period is fairly evident, and may be based on two conditions. First, most of the roadside ditches dry up and, although the King Rail often nests in dry locations in the spring, it is essentially a damp habitat species. Secondly, a fairly uniform and

not too dense or tall a stand is preferred as a nesting site, but in the summer a rank growth usually develops in the ditches.

Other birds frequently associating with the King Rail in these habitats included the Red-wing, Dickcissel (*Spiza americana*), and Short-billed Marsh Wren (*Cistothorus platensis*).

To obtain an idea of breeding density, a count of occupied rail nests was made in the two major nesting types, the roadside ditch and the rice field. In the ditch bordering a paved road four miles north of Stuttgart, five nests were located along a 300-yard strip on May 6, 1952. The width of the ditch averaged 35 feet. On July 15, 1950, at the University of Arkansas Rice Branch Experiment Station, five nests were located in a 70-acre pure-stand rice field.

NEST SITE AND CONSTRUCTION

Most King Rail nests on the Grand Prairie are placed in a fairly uniform stand of vegetation, whether it is rice, oats, sedges, cat-tails, or rushes. The nest may be placed in a tussock or clump of some plant or between several small clumps, parts of which are used in fashioning the canopy and sides of the nest. The platform (including the cup and rim) is constructed usually of the dead stems of the dominant plant type in the vicinity of the nest. In the spring along the roadside ditches, the nest canopies appear as conspicuous mounds in the uniform tracts of vegetation. In one case the entire base of the nest was made of dried mud and was 2¼ inches in depth. The height of the nest depends upon whether it is placed over water and upon the depth of the water. Nests found in dry locations, such as an oat field, canal bank, or dried ditch, are only occasionally elevated, and the eggs may rest within an inch or two of, or actually on, the ground. Nests placed above two or three inches of water may be elevated as much as a foot during a heavy rain or when a rice field is being flooded. On April 12, 1952, following a heavy rain, an incubating rail was observed working feverishly to build up its cat-tail-constructed nest above the rising water in the roadside ditch. It reached out all around the nest to pick up materials (mostly cat-tail leaf fragments), which it tucked beneath the eggs. Most of the canopy was also used in this building process. The bird managed to keep the eggs about two inches above the rising water. The ditch was nearly dry prior to the rain, and the eggs were then five inches from the ground. At flood peak the water was 21 inches deep in the ditch. On another occasion, a nest was found in a rice field that had been temporarily drained. At the time of its discovery, the eggs were 2.5 inches from the ground. The next day water was placed in the

field to a depth of 5 inches, and the eggs were then 7 inches from the ground. As the water continued to rise the incubating bird elevated the eggs by bending over and tucking the rice leaves under them.

The nest may not always be completed before the laying of the first egg. While driving along a paved road south of Stuttgart at 5:30 p. m. in May, I heard two rails uttering their characteristic *jupe-jupe-jupe-jupe-jupe* call. One of the birds was standing in a nearby ditch. After about three minutes of watching, I saw the grass move on the bank opposite the rail in view. As the grass continued to move in the same place it was evident to me that the mate was building a nest. Actually the bird was pulling in the grass to form sides and a canopy for the nest. After watching it for a few minutes I departed. The next morning I found that construction was in the initial stage, but two eggs had already been laid. The eggs were lying on the bare ground and were surrounded by just a few dead plant fragments.

Male and female have been observed together and separately constructing the nest. In one case a pair was discovered building a nest on a small island in a rice field canal. One of the pair sat in the cup as it fashioned the canopy, while its mate stood on the outside bending a blade of grass over the nest. On another occasion I came upon a bird building a nest on a canal bank. I had been watching the process only a minute or so before its mate came to continue the work, at which time the bird that had been at the nest left to feed in a nearby ditch. I watched the second bird for about three minutes, and then collected it. Upon dissection it proved to be the male.

The average measurements, in inches (with extremes in parenthesis), of eleven nests found near Stuttgart were as follows: height from ground to canopy, 17.0 (30.0 and 14.0); height from ground to rim, 7.6 (19.5 and 2.0); exterior diameter, 11.0 (14.5 and 8.5).

The eleven nests were constructed of the following materials: rushes, 6; sedges, 2; cat-tails, 2; and rice, 1.

COPULATION AND EGG-LAYING

Copulation usually takes place near the nest. On April 1, 1952, the following observations were made at nest No. 1. At 5:15 p. m., the male came to within 20 feet of the nest and called. The female returned the call from the nest, then left the nest slowly and walked toward the male. Copulation took place. On two other occasions birds were observed copulating within 30 feet of the nest.

Five nests were under observation during the egg-laying period. When discovered, two nests contained one egg; two nests, four; and one nest, five. An additional egg was deposited in each nest daily until the clutch was complete.

INCUBATION AND CLUTCH SIZE

Bent (U. S. Natl. Mus. Bull. 135: 260–266, 1926) does not give the incubation period of the King Rail. Roberts (The Birds of Minnesota, p. 440, 1936) quotes A. M. Bailey as stating that the incubation period of the King Rail is about 21 days. The writer has found the incubation period to average a little more than 22 days.

One nest was under daily observation from the time the first egg was laid on April 1, until the last egg hatched on May 4. There were 11 eggs in the complete clutch, and incubation started with the laying of the tenth egg on April 10. Thus the incubation period was 24 days. At another nest, incubation began on April 22 or 23, while the eggs hatched on May 13 and 14, giving an incubation period of 22 or 23 days. At two other nests the incubation period was found to be 21 and 22 days, respectively.

Both sexes incubate. To prove this, one night between 9 and 10 p. m., white paint was placed in a small can at the end of a long stick and poured on the incubating birds at two nests. On subsequent visits to the nests, unmarked birds were often seen incubating. An exchange by both sexes during the incubation period was observed at nest number 1 on April 20. At 5:18 p. m. the incubating bird called from the nest; immediately its mate came from the cat-tails across the road to a point about 20 yards from the nest, and began walking toward the nest until it was within five feet. The incubating bird then left the nest and was replaced by its mate, which remained on the nest for 17 minutes, when an exchange again took place.

The average number of eggs per clutch based on complete sets in 16 nests was 10.7, with extremes in clutch size of 8 and 14.

Size of Eggs.—Bent (*op. cit.*) gives the average measurement of 56 eggs as 41 by 30 millimeters with the four extremes as 44 by 32 and 38.5 by 28 millimeters. The writer measured 20 eggs, two from each of 10 nests. Average measurement was 40.8 by 30.4 millimeters, with the four extremes as 42.0 by 32.0 and 39.5 by 29.5.

Belligerence at Hatching Time.—Incubating birds seldom flush until the intruder is right at the nest. As the hatching date approaches they exhibit an even more striking tenacity. On several occasions it has been possible to band the incubating bird, but not without considerable resistance from the bird. On one occasion when I approached a nest at hatching time, the bird flew from the nest and struck me in the chest. On other occasions the birds have struck at my legs; or have run out to my feet and just stood there with wings outstretched. They nearly always feign injury by spreading the wings and fluttering through the vegetation.

NESTING SUCCESS

Sixteen nests containing eggs were under observation during the spring of 1952. One or more eggs hatched in 12 (or 75 per cent) of the nests. The average number of eggs hatched per nest (in 12) was 9.9 (92.5 per cent) out of a potential 10.7. Of 147 eggs found in 16 nests, 119 (80.9 per cent) eggs hatched. A complete clutch of eggs hatched in 5 (31 per cent) of 16 nests. Several nests were found broken up after periods of heavy rain and consequent flooding of ditches and canals.

What is believed to be a valid index of survival is based on the number of young over two weeks old observed in single broods. Such data are difficult to obtain as the complete brood is not always seen. The writer has observed what he believes were full complements in 10 broods. In each case the parent birds were unaware of the observer's presence as the family was seen crossing a road or feeding in a rice field or some other comparatively open spot. The number of young in 10 broods ranged from 2 to 9 with an average of 5. If average hatching success is 9.9 (based on the 12 study nests), then survival rate, after two weeks, is about 50 per cent.

MORTALITY

Adult Birds.—The automobile is one of the important hazards to adult birds. Over a three-month period (March 1–June 1), 24 adult rails were found dead along a 10-mile stretch of paved road north of Stuttgart. A few rails are caught in steel traps during the winter fur season. One trapper with a line of 20 traps reported catching one or two a week. A small number are shot by hunters, particularly during the winter quail season.

Eggs and Young.—In addition to flash flooding, predatory animals are also responsible for breaking up many rail nests. Complete or partial clutches of eggs disappear from nests prior to the hatching date. Two nests found along the edge of a pond were broken up by racoons (*Procyon lotor*) as evidenced by the numerous tracks leading from the nest to a point in the open where the eggs had been taken and destroyed. In the ditches and rice fields the cottonmouth moccasin (*Agkistrodon piscivorus*), various snakes of the *Natrix* group, and certain land snakes are very abundant and probably take many eggs and small young.

WEIGHTS OF EGGS, YOUNG, AND ADULTS

Three eggs were marked on the day they were laid, and weighed on that date and on every seventh day afterward. The average weight

loss during the first week was 0.47 grams; during the second week, 0.83 grams; and during the third week, 1.0 gram. The average total loss from date laid to date hatched was 2.30 grams.

The weights of five young were as follows: 14.3, 14.7, and 15.3 grams (30 minutes after hatching); 12.5 grams (1½ hours after hatching); 12.5 grams (4 hours after hatching). Two 19-day-old young weighed 62.2 and 67.5 grams.

The weights of eggs and of four adult King Rails are given in table 2.

TABLE 2

WEIGHTS OF EGGS AND ADULT KING RAILS

Weights of Eggs (grams)

Number	*First Day*	*7th Day*	*14th Day*	*21st Day*	*Day of Hatching*
1	18.9	18.7	17.8	16.7	?
2	20.3	19.5	18.8	17.9	17.9
3	18.8	18.4	17.5	*	—

Weights of Adult Birds

Sex	*Date*	*Weight (grams)*
Male†	May 18, 1952	339.9
Female‡	April 30, 1952	364.5
Female‡	May 28, 1952	325.0
Female‡	June 15, 1952	305.0

* Clutch destroyed † Alive ‡ Dead

SUMMARY

Thirty-eight nests of the King Rail were found in the vicinity of Stuttgart, Arkansas, during three nesting seasons (1950, 1951, 1952). Most of these were located in roadside ditches in the spring and in rice fields in the summer. Nests are usually placed in a fairly uniform stand, whether it is rice, sedges, cat-tails, or some other vegetation type. Nests are generally placed over water but in some cases are found in dry locations. When water is turned into a ditch or rice field, nests located there are built up above the water level by the incubating bird.

An idea of breeding population density was obtained when five nests were found in a 70-acre rice field, and the same number in a roadside ditch 300 yards long and 35 feet wide.

Egg laying may begin before the nest is completed. Male and female together and separately have been observed building the nest. Eggs are laid daily until the clutch is complete. Average clutch size in the Arkansas rice fields was 10.7 eggs. Eleven eggs were most frequently found. The average size of 20 eggs measured was 40.8 by 30.4 millimeters.

The incubation period was found to average approximately 22 days. Both sexes incubate. One or more eggs were hatched in 12 of 16 nests under observation in the spring of 1952. The number of nests in which a complete clutch hatched was 5, or 31.2 per cent. Average number of eggs hatched per nest (in 12) was 9.9 out of a possible 10.7. Of a total of 147 eggs found in 16 nests, 119, or 80.9 per cent, hatched.

Survival rate of young after two weeks was about 50 per cent. The most important cause of death to adult birds appears to be the automobile. There is little hunting pressure in the Stuttgart area. Nest and eggs are destroyed by floods and various predators, such as snakes and racoons.

Eggs were marked and then weighed every seventh day. Average total loss in weight from date laid to date hatched was 2.30 grams. Average weight of downy young on first day was 13.86 grams. Average weight of two 19-day-old young was 64.85 grams. Average weight of 3 adult females was 331.5 grams; one male weighed 339.9 grams.

U. S. Department of the Interior, Fish and Wildlife Service, Stuttgart, Arkansas, October 20, 1952.

A PHYLOGENY OF THE OSCINES

BY WILLIAM J. BEECHER

INTRODUCTION

IN recent years ornithologists working with passerine birds have grown increasingly aware that they are dealing with a top-heavy classification. Current taxonomic methodology, while permitting vast refinement at the species level, has added nothing to our understanding of the higher categories. Some families are still but vaguely defined, and we know little about the inter-relations of over 60 families in the suborder Oscines (song birds), an assemblage comprising nearly half of all bird species. The situation, alluded to by Mayr and Vaurie (1948: 238), is most serious as it affects the ornithological contribution to the history of world faunas. This contribution can only be a misleading one so long as the arrangement of these families into a phylogenetic tree remains unaccomplished. With few exceptions, the relationships of groups occupying widely-separated faunal regions may only be guessed at now.

The present investigation was undertaken to clarify the relationships of these higher categories of Oscines and to construct a phylogeny by applying the methods of comparative anatomy. Nearly a thousand specimens (over 600 species) from virtually all currently recognized oscinine families were dissected, and the taxonomic arrangement is based mainly on several independent lines of anatomical evidence in the head region, with particular attention to jaw musculature. Thousands of additional skulls and skins were studied, and the classification is not only supported by the external characters normally used in taxonomy but by such non-morphological characters as behavior.

This survey has made nearly exhaustive coverage of the oscinine species in the spirit collections of the United States National Museum, American Museum of Natural History, and Chicago Natural History Museum. A few specimens were borrowed from the Museum of Vertebrate Zoology, from the British Museum (Natural History), and the Dominion Museum (Wellington, N. Z.). For use of, or help in obtaining, specimens, I am indebted to Alexander Wetmore, Herbert Friedmann, Ernst Mayr, Dean Amadon, Charles O'Brien, Frank A. Pitelka, Keith L. Dixon, Richard Meinertzhagen, David Lack, Francis C. Fraser, Robert A. Falla, Karl Plath, Albert J. Franzen, Thurston Wright, Karl P. Schmidt, and D. Dwight Davis. Mayr, Amadon, and Davis also read the manuscript and offered suggestions, as did James L. Peters, John T. Zimmer, James P. Chapin, Jean Delacour,

Josselyn Van Tyne, Alfred E. Emerson, Sewall Wright, and Austin L. Rand. Harvey I. Fisher and Emmet R. Blake gave valuable suggestions and advice. The writer alone is responsible for the classification. This paper is offered in partial fulfillment of the requirements for the Ph.D. degree in the Department of Zoology, University of Chicago.

HISTORICAL

What any discipline is, or even what it may become, is largely influenced by its past history. The refinement of the classification of passerine birds at the species level is a direct outcome of the acceptance of the museum study skin as the ultimate working unit of taxonomy, and this has virtually limited diagnosis to external characters. True, Müller (1845) early differentiated between the oscinine (song) birds and suboscinine birds on the basis of syringial musculature, and anatomy had its brief vogue under Garrod, Gadow, Fürbringer, and others, but none of them attempted the anatomical diagnosis of passerine families. Nor was this vogue in any way widespread; before it and during it, the taxonomy based on skins flourished and in the end may have brought about the early decline of comparative anatomy. Scientists employed by museums were increasingly occupied with describing new species, and it was more productive to mine ornithological knowledge where the vein was rich. Some museums ceased eventually to collect anatomical material.

The universal acceptance of the bird skin is readily understandable. Such a bird specimen with complete data is adequate to diagnose a new species. It shows perfectly the distinctive features of the plumage, feet, and bill, and it permits counting and measuring flight feathers. Species systematics based on skins was invaluable (Mayr, 1942) in demonstrating evolutionary mechanisms. There is, thus, no justification for the extreme view that ornithologists "save the skin and throw away the characters." An anatomical specimen in alcohol is sodden, patternless, tedious to study, difficult to store. It is only regretted that anatomical work at a higher level did not keep pace with the phenomenal growth at the species level. But species could be arranged on the basis of common external characters into genera and these genera into families, so anatomy seemed superfluous. However, it was less easy to arrange families, thus contrived, into larger groups within the order, because the end product of this method is a jumble of *miscellaneous* families that cannot easily be related in a phyletic scheme.

It was deeply ingrained in ornithological opinion that anatomy could yield results only after years of tedious dissection, and too often

osteology was taken up by systematists who hoped to by-pass the musculature. These static morphological comparisons of bony skull processes and muscle scars by workers who apparently made no attempt to understand their adaptive rôle led to much erroneous conjecture. The musculature, largely responsible for these features, is more basic. It is also more conservative than the misleading osteological "characters" (often the expression of only minor muscle slips), and it falls into an easily recognizable hierarchy of pattern.

METHODS AND ASSUMPTIONS

A Working Hypothesis.—The body of this paper necessarily details the characters of the oscinine groups and would be hard to follow without an understanding of my working hypothesis and assumptions which are presented below.

This project was launched five years ago in the spirit of functional anatomy, and it was recognized at once that food-niche specialization has played a dominant rôle in passerine evolution. First, the degree of individual variation in jaw musculature was studied for a number of common species, using from 6 to 10 specimens, without finding the slightest deviation from the typical muscle pattern. Once the negligible degree of anatomical variation within the species was established, it was considered basic to phylogenetic work to determine the extent of variation occurring with diet differences among the species of an entire family. The blackbird family (Icteridae), selected for this initial study (Beecher, 1951a), embraces members which exploit virtually all food-niches occupied by passerine birds. Yet, through extremes of skull modification including thick-billed finch types and thin-billed insect- and nectar-adapted types, a single pattern of jaw musculature persists in the family. This pattern, characterized by the highly pinnate adductors found in finches, helps relate the blackbirds to buntings, while similar features in the latter relate them to the wood warblers. Each of these higher groups in turn exhibits a similar constancy of pattern within itself.

An exploratory survey of the Oscines early in 1947, using a few characters additional to jaw musculature, suggested the feasibility of similarly diagnosing all oscinine families. Moreover, with the added assumption that muscles with parallel fibers are phylogenetically primitive, and pinnate muscles advanced (Beecher, 1951a), it was possible to arrive at a basic morphological type from which all other oscinine types could be derived—so the means existed for linking the families in a phyletic scheme. This basic type, simple in structure and function, is ideally realized in the living Old World warblers, the

Sylviinae (figure 2)—a group with a pattern of parallel-fibered muscles, and which, on distributional evidence, may date back to the Cretaceous. Then we face the final assumption, viz., that a phylogeny may be derived from a morphological tree of relationships, and we can only point out that passerine fossils to date fit well in living families.

The essential uniformity of the parrots, the trogons, and other pantropical non-passerine families today implies early origin before the tropical biota severed tenuous northern connections and retreated to the equatorial regions of Old and New Worlds. In contrast, except for certain eurythermal world-wide families like swallows, passerines are represented by entirely different groups in Old and New World—groups that evidently evolved in isolation from each other *after* the northern exchange corridor was closed. It appears that this order, comprising perhaps the only generalized insectivorous birds at the time flowering plants evolved in the Upper Cretaceous, was in a position to evolve forms to fill the many new niches provided by this plant group. The impact of this abundant new food source, which also conditioned the origin of many insect groups, resulted in a radiation completely out of proportion to that in other orders, so that the numerous passerine families do not show the great morphological disjunctions characteristic of non-passerine ones.

Judging from anatomical and other characters, the insectivorous American vireos (Vireonidae) are apparently descendants of the Old World insect-eaters that were cut off when the northern exchange corridor submerged or became too cold. Subsequently, the vireos gave rise to the entire nine-primaried American assemblage. They appear directly ancestral to the fruit-eating tanagers and the mainly insectivorous warblers, each of which evidently evolved a nectar-adapted line and several finch lines convergently (Beecher, 1951b). In a parallel manner the Sylviidae evolved a similar assemblage adapted to the plant-niches of the Old World, and more recent interchange between these assemblages has been in direct relation to the ability of species to cross the northern cold barrier. This is taken as evidence that the Oscines existed only as insect-eaters when the Vireonidae became isolated in the New World, and we may be justified in assuming that this happened *before* the origin of flowering plants or about the same time. Fossil evidence from passerine birds is notoriously poor, but Milne-Edwards (1867) lists a titmouse and a starling from the Upper Eocene of France (hardly primitive types) and there is evidence of early origin from Suboscines to be given later.

Evolutionary Rates and Taxonomic Categories.—The tenet that only characters not under the influence of adaptation may be used in

taxonomy has been badly misinterpreted. Wright's "genetic drift" and gene linkage provide a theoretical basis for the appearance of but a small proportion of non-adaptive characters at the population level, and Davis (1949: 86) doubts the occurrence of Simpson's inadaptive stages. So do I. In fact, a taxonomist separating species of wood warblers, for example, is engaged in classifying adaptations. What makes taxonomy possible is the existence of different *levels* of adaptation, reflecting that the parts of an organism are evolving at different rates (Simpson, 1944). Each of these warbler species has essentially the same pattern of hind limb musculature, a character holding so far as investigated for the entire order Passeriformes. Each has the same pattern of syringial musculature, a character embracing the entire suborder Oscines—as well as the jaw muscle pattern which is the hallmark of the Parulinae. Each of these characters is adaptive. They differ in being progressively less deep-seated, the jaw muscle pattern reflecting the diet specialization that resulted in a new group. The fact that a jaw muscle pattern *holds for a particular oscinine group* (family) gives it taxonomic value at the family level. The more conservative syringial musculature provides subordinal characters which are safeguards against errors due to external convergence. It prevents classifying, for instance, a tyrannid flycatcher as a muscicapid.

The Convergence Hazard.—That jaw muscle patterns are a clue to phylogenetic relationships at family level had to be determined by testing them against characters of known value. The reality of most oscinine families is unanimously recognized by ornithologists, and the muscle patterns not only hold for these large groups but permit the assignment of those rather rare species whose family affinities were uncertain. Such species often show external convergence with groups to which they do not belong and, where convergent species occupy the same range, the most expert taxonomists may have difficulty in resolving a complex on the basis of external characters alone. The species of the "family" Coerebidae appear to be nectar-adapted warblers and nectar-adapted tanagers (Beecher, 1951b), and the subfamilies of finches, arising from warblers and tanagers, will be shown to be convergent. A more complicated case of convergence at generic level was indicated in the American orioles (Beecher, 1950).

In classifying the oscinine families, one must face the practical task of assigning species whose affinities cannot be decided on external characters alone (Mayr and Amadon, 1951). The anatomical placing of such convergent species as exist in spirit collections was not hard and is not highly subjective. This is because the reality of the groups,

as diagnosed by internal as well as external characters, is a matter of fact, however much one may question their arrangement into a phyletic scheme.

At the same time precautions were taken against being misled by convergence in the jaw muscle patterns which, rarely, approach each other without indicating near relationship. As a safeguard, several additional characters, forming completely independent lines of evidence, were studied in all specimens and are figured. The relief pattern of the horny palate was greatly valued by Sushkin (1927: 3) for diagnosing large groups of birds. It shows great conservatism and is often useful in linking related groups (Beecher, 1951b). Like the musculature it is more complex in advanced groups and affords further opportunities for group distinctions between convergent groups forming terminal twigs like the finch groups. We now know that the bill itself may often show convergent resemblance in unrelated groups,

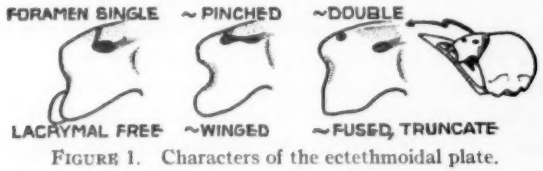


FIGURE 1. Characters of the ectethmoidal plate.

but a palate facies persists in a family—even through the varied bills of icterid genera (Beecher, 1951a)—so the character is useful when supported by collateral evidence. Operculation of the nostril and rictal bristles vary adaptively in a group as does the tongue, and therefore these must be weighted accordingly. The free lacrymal (figure 1), constant for whole assemblages of families, may occur in scattered individual species of other groups, possibly as an adaptation to forward vision. The ectethmoid foramen (figure 1), conducting the olfactory nerves through the bony plate separating the orbital and nasal cavities, is always single in primitive stem groups. In more advanced groups, particularly in the superfamily Sylvioidea, a general tendency toward pinched or double foramina is noted, and this is also constant in a group. The ectethmoid itself may be unusually winged or truncate.

The Real Problem in the Oscines.—The striking anatomical uniformity of all oscinine families, except with regard to the feeding mechanism, presented a peculiar problem. We had constant characters tying the families together (the hind limb and syringial musculature) and characters for distinguishing the families fairly well. But we lacked characters for showing the relation of the families to each

other. The jaw muscle patterns with a few additional characters of head and bill do this—and only *because* they reflect adaptive differences in food preference between families. If we may judge from the present diet of most families, their entire evolution is the result of selection pressure acting on primitive insectivorous stocks arising from the stem Sylviidae—pressure to fill the new food-niches provided by the flowering plants. The jaw muscle patterns simply confirm the reality of the families as true groups already recognized on other lines of evidence, so this is hardly a one-factor diagnosis of families. But in addition these patterns perform the needed function of ranging the families in a hierarchy from simple (presumably primitive) to complex (presumably advanced) families. No other traits are likely to do this.

In this hierarchy, the muscle patterns suggest that some of the groups are of lower level and should be subfamilies. For instance, the differences in muscle pattern between primitive groups at or close to the stem stock may be slight. Between the warblers (Sylviinae), flycatchers (Muscicapinae), and chats (Saxicolinae) there is little difference in muscle pattern, so added characters are needed to tell them apart. The Sylviinae always have the ectethmoid foramen single, the other two double. Of the other two, the Saxicolinae often have the outer of the two foramina outside or nearly outside the orbit and have a much narrower bill. Here muscle pattern combines related groups into larger families, other characters being necessary to differentiate the subfamilies. This suffices to show that more than jaw musculature is used in my phyletic arrangement; there are not sixty different muscle patterns in the Oscines! But as the more advanced groups diverge from the stem Sylviidae, greater complexity of the jaw musculature permits designation of small but constant facies differences for nearly all families.

My arrangement is not a single-factor diagnosis of families. The families were already diagnosed by other lines of evidence. The jaw muscle patterns provide what is so far found nowhere else in the morphology of the Oscines—a key to relationships of all families. They are apparently directly due to phylogenetic differentiation as the families became adapted to new food types.

The Illustrations.—In anatomical work nothing can take the place of accurate drawings. For those who cannot accept my interpretations, they represent facts to be reassessed. Several families are presented in each figure. For each, the small skull vignettes give a general idea of structure and at the same time outline in black the muscle area enlarged. Thus the jaw muscle pattern is shown in side view and in oblique view, looking into the orbit from which the eye

has been removed. The ectethmoid plate is drawn at the top left. The tongue is drawn at the top right and below it the relief pattern of the horny palate—below that the bill. Nomenclature follows the sauropsid terminology of Lakjer (1926), but for easy comparison, muscle masses are numbered from 1 to 7 with subdivisions a, b, and c. Figure 2 serves as the key and may be referred to when necessary to determine the name of a particular muscle; but it is easy to memorize the position of each muscle by number since there are always just seven in the Oscines, and the discussion will be restricted to numbers.

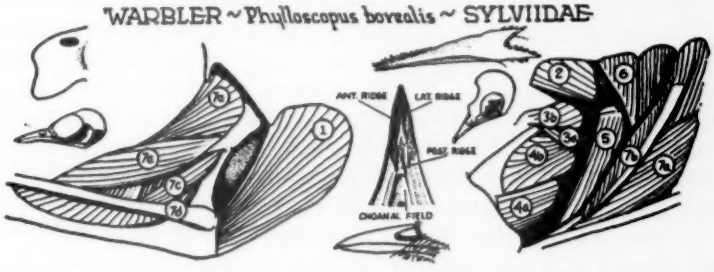


FIGURE 2. Detail drawing of jaw muscle pattern of an Old World warbler, showing primitive (parallel) musculature, with characters of ectethmoid plate, tongue, horny palate, and bill.

Protractors. 1 depresses the lower mandible; 2 elevates the upper mandible.

1. *M. depressor mandibulae*
2. *M. protractor quadrati*

Palatine retractors. Combined action draws upper mandible downward.

3. *M. pterygoideus dorsalis:* a) *anterior;* b) *posterior*
4. *M. pterygoideus ventralis:* a) *anterior;* b) *posterior*
5. *M. pseudotemporalis profundus*

Mandibular adductors. Combined action draws lower mandible upward.

6. *M. pseudotemporalis superficialis*
7. *M. adductor mandibulae:* a) *externus superficialis;* b) *externus medialis;* c) *externus profundus;* d) *posterior*

The origins and insertions of muscles and their specific functions in the kinetic bird skull are well-described in Moller (1931) and Fiedler (1951). The brief discussion in Beecher (1951a) may be enough for general needs, and figure 2 in that paper, showing mass functions of muscles, should help in visualizing functional emphasis in various groups.

The family diagnoses of Sharpe (1874–1898), Ridgway (1901–1907), and others were really detailed accounts of the range of variation in the group and often failed to eliminate species which they did not intend to include. To save space some features of the familiar key are adopted here. Superfamily and assemblage characters are not re-

peated under group *diagnoses*, which are very brief, so that the figures themselves must take the place of lengthy description. To show relationships, similarities are often emphasized, but each group has a combination of characters that sets it apart from other groups.

DIAGNOSES AND PHYLOGENY OF THE OSCININE HIGHER GROUPS

If we erect a phylogeny on the basis of jaw muscle patterns and other internal and external characters, the logical procedure is to work outward from the simple and primitive to the complex and advanced. We thus arrive at a typical tree with the weak-billed insect-eaters at the base giving rise to stronger-billed shrike-flycatchers and shrikes, or to nectar-, fruit-, and seed-adapted or omnivorous groups as the terminal twigs (figure 18). We find that these terminal groups are in every way more complex, with increased pinnate musculature, stronger bills, more intricate palate relief, a tendency toward double ectethmoid foramina, and generally more complex plumage, habits, and behavior. But it follows that these differences decrease as we come lower down in the tree and, where a number of groups leave the stem Sylviidae, their relationships are often not so clear. Whether they come from each other, from the Sylviidae or from a common ancestor may never be known. Where such cases arise I have tried to present the problem and give reasons for my own decision.

A major phylogenetic division of oscinine families into the superfamilies Sylvioidea and Timalioidea appears possible, largely on the basis of the parallel or pinnate character of adductor slip *M7b* (figure 2). Though small, this difference holds remarkably well for these two large groups, and one is tempted to conjecture that inability to evolve a pinnate *M7b* prevented Sylvioidea from producing shrike or finch adaptations so typical of the more numerous Timalioidea in which it is pinnate. Theoretically, the simpler Sylvioidea, embracing the stem Sylviidae (figure 18), evolved the Timalioidea with its complex *M7b* via such a group as the Cisticolinae, then may have been unable to go further in this direction against the competition of that group. However, it did apparently evolve several family assemblages with a parallel *M7b:* the crows, cuckoo-shrikes, and bulbuls; the flycatchers, thrushes, swallows, and starlings; the Old World nectar-feeders, exclusive of the Meliphagidae.

This major division is most open to question at the very stem where the grass and bush warblers (Cisticolinae) are split off from the sylviine warblers (Sylviinae) as the basic stock of the Timalioidea. Here further study may reveal a gradient between the two warbler groups rather than a sharp break. But in drawing a phylogenetic tree it

would still be necessary to recognize the extremes of the gradient as having different evolutionary potentials due to parallel or pinnate *M7b*. The timalioid flycatchers (Monarchidae), however, seem to be separated from the sylvioid flycatchers (Muscicapinae) by an absolute dichotomy of four characters. The former has *M7b* pinnate, ectethmoid winged, foramen single, young unspotted; the latter has *M7b* parallel, ectethmoid truncate, foramen double, young spotted. They may prove homogeneous, but present evidence suggests partial parallelism in ecological niche (and hence in plumage) following slight initial divergence. With this preamble we now take up the higher groups and, since it would be impossible to express their relationships in any linear sequence (figure 18), each line is pursued to its evolutionary termination from supposed beginnings in the stem Sylviidae.

THE SUPERFAMILY SYLVIOIDEA

This is the smaller of the two superfamilies making up the suborder Oscines and may have been restricted in its adaptive radiation through competition with the more efficient Timalioidea.

OLD WORLD INSECT-EATERS (SYLVIIDAE).—The several subfamilies listed are regarded as having evolved to fit different food-niches: warblers (Sylviinae), bulbuls (Pycnonotinae), flycatchers (Muscicapinae), and grass warblers (Cisticolinae). All have the ectethmoid truncate, its foramen single (except Muscicapinae), and the lacrymal fused (figure 1).

WARBLERS (SYLVIINAE).—*Diagnosis:* Muscle pattern (figure 2) simple, parallel; *M6* bifid. Bill notched, weak, narrow, with operculate nostril and rictal (and often nasal) bristles. Palate relief simple with lateral and central ridges disappearing posteriorly, the latter separated by a slight vault from a posterior ridge encircling the choanal field. Tongue slender with extensive reedy tip. (By "reedy" I mean blade-like. The passerine tongue usually ends in an extension of the ventral keratinized sheath, resembling the reed of a clarinet.) Ten-primaried, world-wide insect-eaters with mainly plain plumage, unspotted young. *Species dissected: Abroscopus schistaceps, Acrocephalus arundinaceus, Calamocichla newtoni, Calamonastes cinereus, Camaroptera griseiventris, Camaroptera sp., Chlorotesia sp., Cryptolopha sp., Conopoderas familiaris, Dromaecercus seebohmi, Ephthianura tricolor, Erythrocercus mccalli, Macrosphenus concolor, Oligura superciliaris, Orthotomus sutorius, Phylloscopus borealis, Polioptila dumicola, P. plumbea, Ramphocaenus rufiventris, Seicercus poliogenys, Seicercus sp. Discussion:* The diagnostic characters, including the single foramen, are considered primitive, and this world-wide group fulfills the requirements of an ancestral oscinine stock. The similarity of the long-billed *Orthotomus, Macrosphenus,* and *Ramphocaenus* poses a problem (Rand and Traylor, 1953), but I regard them as independent, endemic derivatives of generalized sylviid stock in the Oriental, Ethiopian, and Neotropical regions respectively—not closely related species. *Function:* These three genera differ from generalized warblers in greater expansion of the protractors *M1* and *M2* for prying in the manner of starlings and American icterids

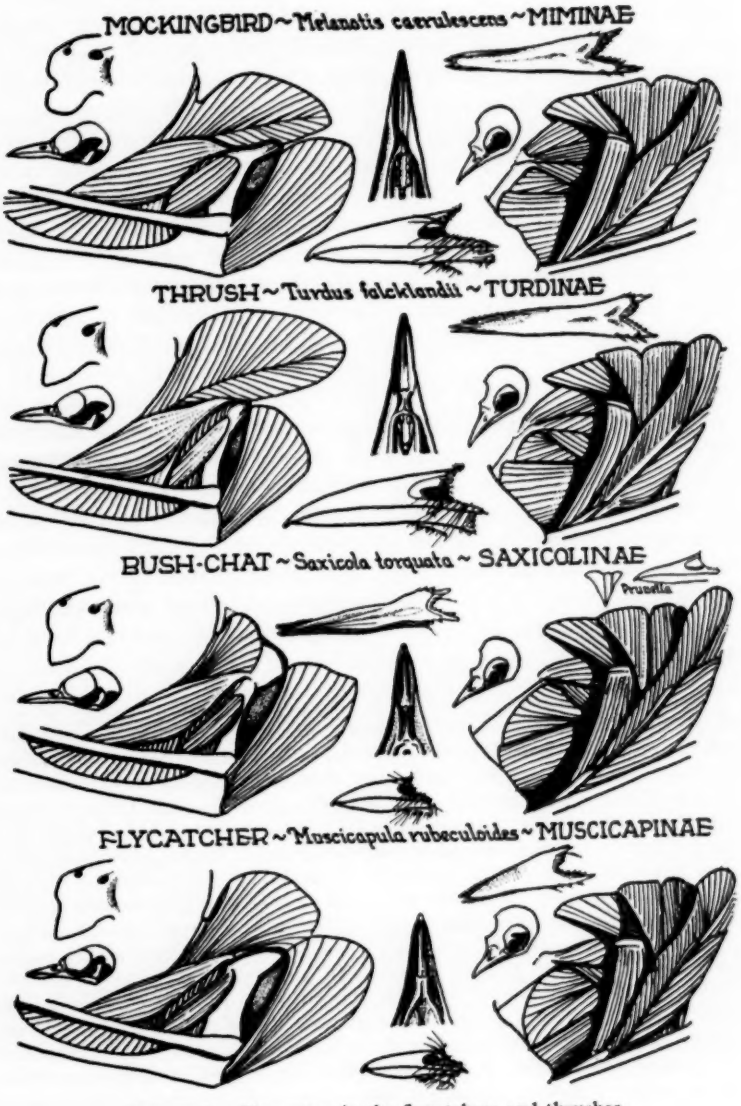

MOCKINGBIRD ~ Melanotis caerulescens ~ MIMINAE
THRUSH ~ Turdus falcklandii ~ TURDINAE
BUSH-CHAT ~ Saxicola torquata ~ SAXICOLINAE
Prusilla
FLYCATCHER ~ Muscicapula rubeculoides ~ MUSCICAPINAE

FIGURE 3. Characters in the flycatchers and thrushes.

(Beecher, 1950; 1951a). This is further evident in the dorso-ventral strengthening of the laterally compressed bill, especially in *Macrosphenus* which pries in dead branches for insects (Bannerman, 1936: 127).

FLYCATCHER, THRUSH, STARLING, SWALLOW ASSEMBLAGE.—Arising from Muscicapinae (figure 18), these groups show strong affinities in plumage and internal structures, but diverge in feeding adaptations. All have the ectethmoid truncate (except Sturnidae), foramen double, and lacrymal fused.

FLYCATCHERS (MUSCICAPINAE).—*Diagnosis:* Muscle pattern (figure 3) similar to that of the Sylviinae but aponeurosis of *M7b* very narrow. Bill notched, broad, flat, with non-operculate nostril and abundant rictal and nasal bristles. Palate as in Sylviinae but no vault, the posterior ridge crowding the central one anteriorly. Ectethmoid truncate. Broad tongue tapering to short, bifid, reedy tip. Ten-primaried Old World flycatchers with plain or streaked plumage and spotted young. *Species dissected: Anthipes moniliger, Arizelomyia latirostris, Artomyias sp., Culicicapa ceylonensis, Melaenornis sp., M. pammelaina, Muscicapa latirostris, M. murinus, M. parva, M. rubeculoides, M. sundara, M. thalassina, M. tickelliae, Stizorhina fraseri.* Following Delacour (1947) I have synonymized 7 genera under *Muscicapa*. *Discussion:* Double ectethmoid foramen, spotted young, and flycatching may be advances over Sylviinae. *Artomyias*, with flycatcher behavior and musculature but wing, skull, and bill approaching the swallows, suggests how this group could have evolved the Hirundinidae.

THRUSHES (TURDIDAE).—The included subfamilies, linked by several lines of evidence, appear to be diverging under selection by slightly different food-niches: chats (Saxicolinae), thrushes (Turdinae), mimic thrushes (Miminae), and dippers (Cinclinae).

CHATS (SAXICOLINAE).—*Diagnosis:* Muscle pattern (figure 3) similar to that of the Muscicapinae but generally weaker adductors *M7a* and stronger palatal retractors *M4a*. Protractors *M1* and *M2* reduced. Unlike Muscicapinae, the outer ectethmoid foramen (figure 1) is often outside or nearly outside the orbit. Bill notched, narrower than in Muscicapinae, non-operculate (except *Prunella*), rictal bristles virtually lacking. Palate similar to that of the Sylviinae but posterior ridge less prominent. Tongue also similar to that of the Sylviinae. Ten-primaried flycatchers, mostly terrestrial, and Old World, with usually plain (some streaked) patterns and spotted young. *Species dissected: Brachypteryx leucophrys, Cercomela familiaris, Cichladusa sp., Copsychus saularis, Enicurus maculatus, Erithacus rubecula, Erythropygia barbata, Ixoreus naevius, Kittacincla malabarica, K. tricolor, Luscinia calliope, L. cyanea, L. sibilans, L. svecica, Myiadestes genibarbis, Myiomela leucura, Myrmecocichla arnauti, Oenanthe oenanthe, Oxylabes madagascariensis, Phoenicurus ochruros, P. phoenicurus, Pratincola sp., Prunella modularis, Saxicoloides fulicata, Sialia sialis, Thamnornis chloropetoides, Zeledonia coronata. Discussion: Oxylabes* and *Thamnornis* have often been put in the Timaliidae or Sylviidae, but the double ectethmoid foramen and complex *M3b* (never found in those groups) place them here. *Prunella* has very strong palatal ridges; its trifid *M6* and the trifid pinnate *M6* of *Zeledonia* are unique in this family. Both should be given at least the status of tribes, the Prunellini apparently being nearest *Phoenicurus*. *Function:* The chats seem to stem directly from the Muscicapinae on the basis of plumage (especially spotted

young) and internal characters. In *Muscicapa* (Muscicapinae) fibers split off *M3b*, to form a distinct *M. retractor palatini*, inserting on the basitemporal; this "complex" *M3b*, retracting the palate and drawing the upper mandible down powerfully, is elaborated in the chats *Oxylabes, Thamnornis, Saxicoloides, Oenanthe, Erithacus, Phoenicurus, Myiadestes,* and *Sialia*. In *Cichladusa* and *Enicurus* (the aquatic forktail), *M3a* is advanced anteriorly along the palatine clasp as in the dipper, *Cinclus*, and this added retracting power may be related to holding slippery prey. Revision by Ripley (1952).

THRUSHES (TURDINAE).—*Diagnosis:* Muscle pattern (figure 3) similar to that of the *Saxicolinae* but more massive, with complex *M3b* and pinnate temporal slip of *M7a*. Bill notched, stronger, non-operculate, with rictal bristles. Palate similar but with papillae anterior to choanae. Tongue as in Saxicolinae. World-wide, ten-primaried ground-feeders. *Species dissected: Hylocichla guttata, H. ustulata, Mimocichla sp., M. rubripes, Myiophonus temminckii, Oreocincla lunulata, Turdus falcklandii, T. migratorius, Zoothera sp. Discussion:* The thrushes seem to be more terrestrial than chats. *Function:* The dorso-ventral strengthening of the laterally compressed bill, especially in *Myiophonus* and *Zoothera*, with the massive retractor *M3b*, may be an adaptation for grasping slippery prey, and the evolution of some forms may be associated with a diet of earthworms. Revision by Ripley (*op. cit.*).

MIMIC THRUSHES (MIMINAE).—*Diagnosis:* Muscle pattern (figure 3) similar to that of the Turdinae but *M7a* smaller, *M6* and *M1* larger. Bill, palate, and tongue similar, but bill usually decurved (bill of *Toxostoma* is un-notched, palate flat). Ten-primaried New World ground-feeders with plain, streaked, or spotted plumage. *Species dissected: Cinclocerthia ruficauda, Donacobius atricapillus, Dumetella carolinensis, Margarops fuscatus, Melanoptila glabrirostris, Melanotis caerulescens, Mimodes graysoni, Mimus gundlachii, M. polyglottos, Nesomimus trifasciatus, Oreoscoptes montanus, Toxostoma curvirostre, T. longirostre, T. rufum. Discussion:* The double ectethmoid foramen and the muscle differences suggest that the supposed affinity of the Miminae to the babblers or wrens is the result of convergence. The Miminae may stem from the Turdinae, via *Margarops* for instance, thrashers being a specialized end product. *Function:* The palate-retracting musculature of ancestral thrushes might preadapt thrashers for pick-ax digging (Engels, 1940) by bracing the more solid, bony mandibles against resistant earth.

DIPPERS (CINCLINAE).—*Diagnosis:* Muscle pattern (figure 4) similar to that of the Turdinae but *M3a* advanced anteriorly on the palatine clasp. Protractors *M1* and *M2* expanded. Bill narrow, notched, dorso-ventrally strengthened, upturned, operculate, without rictal bristles. Palate and tongue similar to those of the Turdinae but narrower. Ten-primaried world-wide, montane, stream-bottom feeders. *Species dissected: Cinclus mexicanus. Discussion:* This group may have arisen from the Saxicolinae. The forktails (see *Microcichla*) show most of the adaptations of dippers, even the advanced *M3a* and aquatic feeding; but they retain rictal bristles and lack the dense plumage. *Function:* The expansion of protractors *M1* and *M2* and dorso-ventral strengthening of the upturned bill suggests some prying under the rocks of stream beds in both groups.

SWALLOWS (HIRUNDINIDAE).—*Diagnosis:* Muscle pattern (figure 4) similar to that of the Muscicapinae but adductors *M6* and *M7* weaker, protractors *M1* and *M2* expanded. Bill notched, very broad and flat with operculate nostril and vestigial rictal bristles. Palate broad, with weak relief; tongue broad, tapering to a short, bifid, reedy

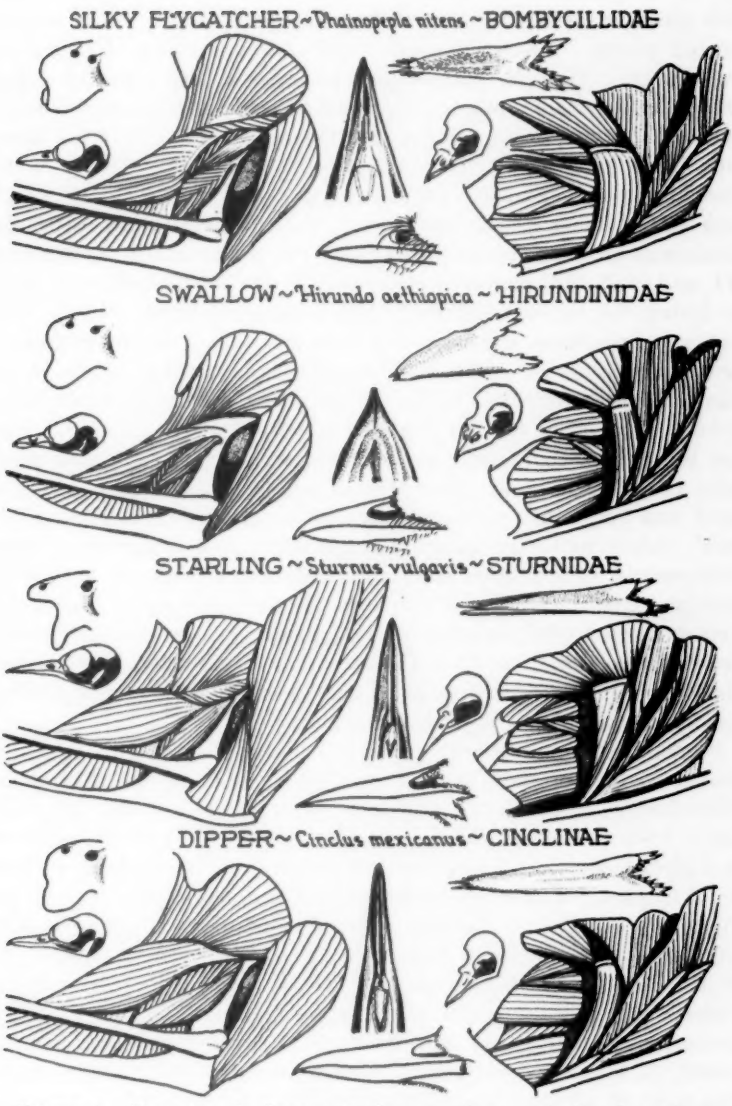


FIGURE 4. Characters in dippers, starlings, swallows, and silky flycatchers.

tip. Nine-primaried (tenth vestigial), world-wide aerial insect-eaters with plain or streaked (often iridescent) plumage and more or less spotted young. *Species dissected: Hirundo aethiopica, H. tahitica, Iridoprocne albiventris, Lamprochelidon sclateri, Petrochelidon fulva, Progne subis, Psalidoprocne fuliginosa, Pseudochelidon eurystomina, Pygochelidon cyanoleuca, Tachycineta thalassina. Discussion:* I agree with Lowe (1938) that *Pseudochelidon* is an aberrant swallow, the bronchial half-rings (instead of full rings) suggesting relationship with such a flycatcher as *Artomyias*. It has no connection with the Artaminae or Prionopinae. *Function:* The expansion of protractors *M1* and *M2* will permit wider opening of the mouth, especially by lifting the upper mandible. The forward-directed, black, loral feathers of swallows, starlings, and some flycatchers are under muscular control (Lorenz, 1949) and constitute a functional lens-shade associated with forward vision. In the same connection the ectethmoid plate of swallows and starlings falls short of the zygoma. The jaw musculature and associated characters suggest that both stem from the Muscicapinae along with Turdidae. Both have vestigial tenth and long ninth primaries like *Artomyias* as well as partial forward vision with specialized loral feathers. A few muscicapids, *Melaenornis* for example, have iridescent black plumage similar to that in some starlings and martins. Similar plumage patterns are seen in the following swallow-starling pairs: *Iridoprocne-Pholia, Hirundo-Cinnyricinclus, Progne-Aplonis, Hirundo-Saroglossa.* Streaked plumage occurs in some swallows and flycatchers (*Muscicapa, Artomyias*) and, as a rule, in juvenal starlings.

STARLINGS (STURNIDAE).—*Diagnosis:* Muscle pattern (figure 4) similar to that of the Turdinae in complex *M3b* and to that of the Hirundinidae in small *M6* and large protractors *M1* and *M2*. Bill varies from the un-notched wedge of *Sturnus* to the stout, notched, and arched beak of *Gracula;* nostril usually non-operculate; without rictal bristles. Palate generally vaulted and resembling that of the Turdinae, but flat in *Sturnus*. Ectethmoid winged. Tongue with bifid tip. Ten-primaried (short tenth and very long ninth) Old World fruit- and insect-eaters. *Species dissected: Acridotheres tristis, Aplonis grandis, A. metallicus, A. minor, Cinnyricinclus leucogaster, Gracula religiosa, Mino dumontii, Scissirostrum dubium, Sturnus contra, S. roseus, S. vulgaris. Discussion:* See Hirundinidae above. *Function:* Starlings, especially ground-feeders, have the protractors *M1* and *M2* extremely large in association with prying. *Sturnus* repeatedly parts the grass mat or probes by spreading the mandibles, at the same time directing the eyes between them. Birds with marked

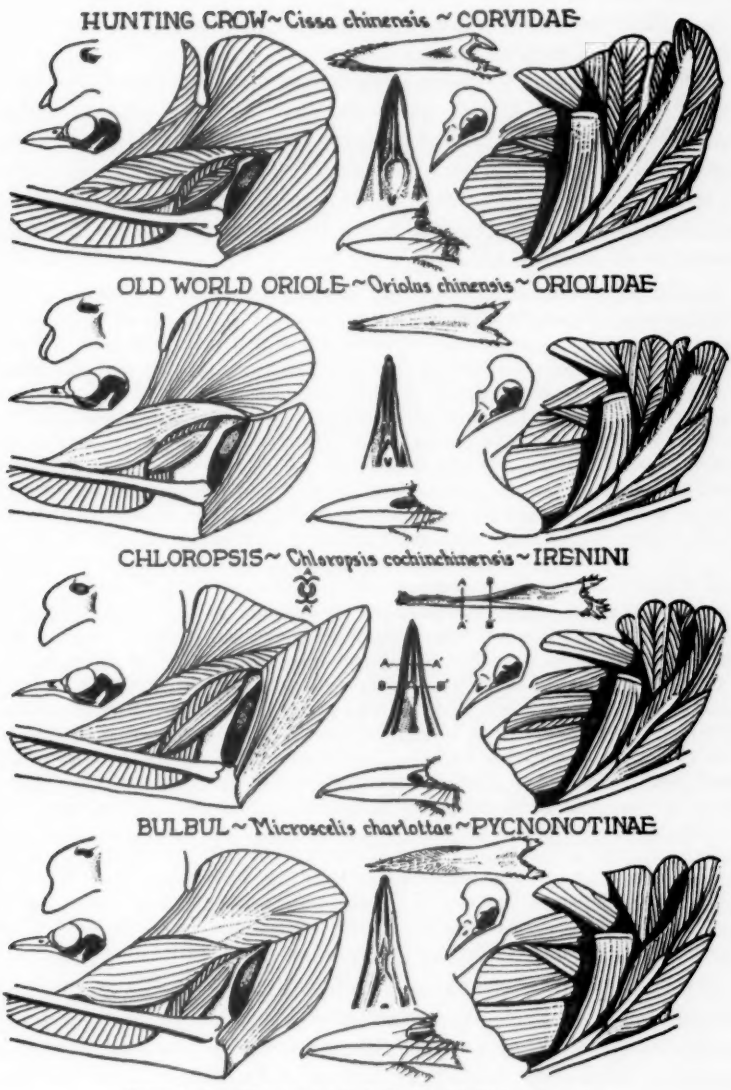


FIGURE 5. Characters in bulbuls, orioles, and crows.

forward vision of this sort have a temporal as well as the usual central fovea. The complex *M3b* may be for the same purpose noted in the Turdidae. Revision by Amadon (1943).

BULBULS, CORVINE BIRDS, WAXWINGS. CUCKOO-SHRIKES, AND NECTAR-FEEDERS.—All of these groups (families below) appear traceable to the bulbuls, here regarded as a specialized branch (Pycnonotinae) of the Sylviidae. *All have M7b very short*, its insertion on the inside surface of the mandible far posterior to that of *M7a* on the outside surface. Ectethmoid truncate. Single foramen becoming double in all terminal groups.

BULBULS (PYCNONOTINAE).—*Diagnosis:* Muscle pattern (figure 5) similar to that of the Sylviinae (especially *Macrosphenus*), the fibers of *M7a* (temporal slip) converging in an aponeurosis and *M7b* short (ventral slip of *M7c* not seen in figure). Outer slip of *M6* longer than the inner with a large gap between the latter and *M2*. Foramen single or pinched (double in *Andropadus*). Bill notched, slender to stout, generally decurved, operculate, with rictal bristles. Tongue generalized, but tendency for the horny papillae to be double-ranked. Palate as in the Sylviinae but posterior ridge reduced. Ten-primaried Old World (not Australian) fruit- and insect-eaters, usually with inconspicuous warbler-like plumage. *Species dissected: Criniger tephrogenys, Iole olivacea, Microscelis macclellandi, M. tickelli, M. virescens, Phyllastrephus strepitans, P. terrestris, Pycnonotus barbatus, P. cafer, P. dispar, P. finlaysoni. Discussion:* The characters distinguishing this subfamily from Sylviinae seem to link it to various derived groups below. *Function:* The more massive musculature agrees with a stronger bill while the expansion of *M1* and *M2* suggests added prying ability. Delacour's (1943a) "family" characters are weak; his assertion that the neck is short is not supported by skeletal material.

FAIRY BLUEBIRD, CHLOROPSIS (IRENINI).—*Diagnosis:* Muscle pattern (figure 5) pycnotine but *M3a* advanced, bifid *M6* (trifid in *Chloropsis*); *M1* and *M2* emphasized. Ectethmoid foramen double. Tongue, bill, and palate pycnonotine, but *Chloropsis* with nectar adaptations (see below). *Species dissected: Chloropsis cochinchinensis, Irena puella. Discussion:* Many features of derived groups are forecast in this tribe of the Pycnonotinae, which does not include *Aegithina* or *Aethorhynchus;* the forward advance of *M3a* on the palatine clasp, trifid *M6*, reduction of rictal bristles, increased pinnate character of the muscles, expanded protractors, and the curled, whipped-out, nectar-adapted tongue (*Chloropsis*). *Function:* Vacuum is apparently created in this sucking tongue by catching its tubular part between the opposing ridges of upper and lower mandibles (A–A′) while the palatal boss engages the notch of the tongue (B–B′). In this position the brushy tip protrudes beyond the bill tip.

THE CORVINE ASSEMBLAGE.—This group, comprising the Ptilonorhynchidae, Callaeidae, Paradisaeidae, and Corvidae, is typified by double ectethmoid foramen, free lacrymal, advanced *M3a*, short *M7b*, tendency to pinnate adductors, loss of rictal bristles, and plumage specialization. The Oriolidae, a primitive group close to the Corvidae, has *M3a* not advanced as in jays.

BOWER BIRDS (PTILONORHYNCHIDAE).—*Diagnosis:* Muscle pattern (figure 6) similar to that of the Pycnonotinae but adductors *M7a* and

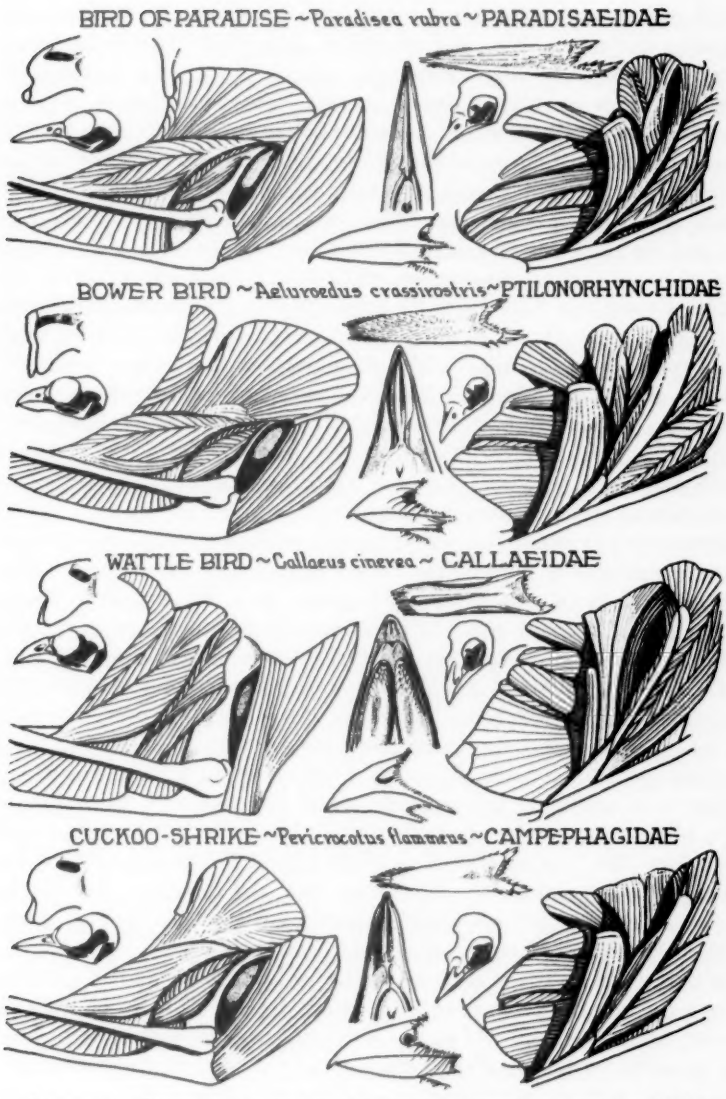

BIRD OF PARADISE ~Paradisea rubra~ PARADISAEIDAE
BOWER BIRD ~Aeluroedus crassirostris~PTILONORHYNCHIDAE
WATTLE BIRD ~Callaeus cinerea~ CALLAEIDAE
CUCKOO-SHRIKE ~Pericrocotus flammeus~CAMPEPHAGIDAE

FIGURE 6. Characters in cuckoo-shrikes and Australian crow-like birds.

M7c pinnate, *M3a* advanced. Bill notched, arched, stout to slender; nostril operculate or feathered; without rictal bristles. Tongue with radiating surface-papillae and quadrifid, reedy tip. Palate (*Aeluroedus*) with posterior ridge joined to anterior or (*Prionodura*) with posterior ridge greatly reduced as in *Pycnonotus layardi*. Ten-primaried corvid-like fruit- and insect-eaters of the Australian region. *Species dissected: Aeluroedus crassirostris*. *Discussion:* Affinity to the Pycnonotinae is seen in the gap between *M2* and *M6* and in the characters of the corvine assemblage, even in the specialized *Aeluroedus*, but on the basis of external characters, the bulbuls are disjunct from their presumed descendant groups (cf. Delacour, 1943). The papillate tongue of *Aeluroedus* is approached by *Pycnonotus finlaysoni*, and partial resemblance in plumage is seen in bulbul-bowerbird pairs like *Trachycomus-Sericulus, Chloropsis-Xanthomelas*. Some members of both groups are mimics. But the Pycnonotinae do not reach the Australian region, and we are obliged to assume that the ancestral bulbul-like stock which reached there evolved into the endemic families treated here and below. *Function:* Adduction and palate retraction as throughout assemblage.

BIRDS OF PARADISE (PARADISAEIDAE).—*Diagnosis:* Muscle pattern (figure 6) similar to that of the Ptilonorhynchidae but *M6* trifid pinnate, *M7b* reduced, and *M1* and *M2* expanded. Bill notched (except in riflebirds), without rictal bristles; nostril operculate or feathered. Palate with long central ridge fused to posterior ridge. Tongue surface papillate with double-ranked horny papillae posteriorly. Lacrymal free in *Ptilorhis*, fused in *Paradisea*. *Species dissected: Paradisea rubra, Ptilorhis paradisea*. *Discussion:* If this actually is another corvid-like endemic group which evolved in the Australian region from ancestral pycnonotine stock, the tendency toward bare nape in bulbuls may be associated with often naked nape in the Paradisaeidae; the long nape "hairs" of the bulbul *Tricholestes* may be the "anlagen" of feather specialization, the red-throated mutant of *Pycnonotus dispar johnstoni* (de Schauensee, 1946: 53) the forerunner of the bright coloration in descendant groups.

WATTLE BIRDS (CALLAEIDAE).—*Diagnosis:* Muscle pattern (figure 6) nearest that of *Aeluroedus* but *M6* trifid, temporal slip of *M7a* reduced; *M7c, M4a*, and *M1* expanded. Bill un-notched, varying from the straight wedge of *Philesturnus* to the arched beak of *Callaeas*, operculate, without rictal bristles. Palate with lateral bosses papillate like the tongue of *Aeluroedus*. Tongue truncate with quadrifid tip and raised mid-rib suggested in *Aeluroedus*. Endemic New Zealand leaf- and insect-eaters. *Species dissected: Callaeas cinerea, Philestur-*

nus carunculatus. *Discussion:* A primitive corvid-like group most closely allied to bower birds (plumage pattern of *Callaeas* resembles that of the related cuckoo-shrikes). *Function:* the palate in *Callaeas* (raised as in *Phytotoma*) is adapted for leaf-eating. *Philesturnus* is convergent with *Sturnus* in having enlarged protractors *M1* and *M2*, otherwise like *Callaeas*.

OLD WORLD ORIOLES (ORIOLIDAE).—*Diagnosis:* Muscle pattern (figure 5) similar to that of the Pycnonotinae, but *M6* trifid and pinnate. Bill notched, of moderate strength, operculate, with rictal bristles. Tongue unspecialized. Palate with central ridge more or less confluent with weak posterior ridge. Ten-primaried Old World fruit- and insect-eaters. *Species dissected: Oriolus chinensis, O. xanthornus*. *Discussion:* Similar in plumage to some of the Pycnonotinae; in some ways, this unspecialized, anatomically primitive group also parallels the jays.

CROWS, JAYS, MAGPIES (CORVIDAE).—*Diagnosis:* Muscle pattern (figure 5) similar to that of the Oriolidae, but *M7a* and *M7c* pinnate and outer slip of *M6* advancing its insertion on the mandible (in *Corvus M3a* likewise is advanced). Bill seldom distinctly notched; rictal bristles present; nostril feathered. Tongue with horny papillae double-ranked. Palate usually with posterior ridge suppressed, but fused with central ridge in *Cissa*. Ten-primaried world-wide omnivores. *Species dissected: Aphelocoma ultramarina, Cissa chinensis, Cissilopha melanocyanea, Corvus brachyrhynchos, Crypsirhina iemia, Cyanocitta cristata*. *Discussion:* The partly pinnate adductors of the Oriolidae are intermediate between the pinnate adductor musculature of the Corvidae and the mainly parallel musculature of the Pycnonotinae. The variable black and white plumage of the bulbul *Microscelis madagascariensis* suggests that of the Corvidae; anatomically, the bower birds are intermediate between bulbuls and crows. *Function:* In most of these omnivores, hammering plays a role in food-getting. Revision by Amadon (1944).

THE CUCKOO-SHRIKE, WAXWING ASSEMBLAGE.—The families of this assemblage seem to have arisen from the Pycnonotinae mainly with plumage and diet specialization and with the internal specialization of free lacrymals. Ectethmoid truncate. Foramen variable, but double in most advanced forms.

CUCKOO-SHRIKES (CAMPEPHAGIDAE).—*Diagnosis:* Muscle pattern (figure 6) as in the Pycnonotinae, but the insertion of *M3a* advanced and the gap lacking between *M2* and *M6*. Bill notched; rictal bristles present; nostril feathered. Palate vaulted with central ridge disappearing posteriorly (crow-like). Tongue with papillae

double-ranked ventrally and "quadrifid" tip (bifid with lateral fringes). Ten-primaried Old World fruit- and insect-eaters. *Species dissected: Coracina lineata, C. melanops, C. papuensis, Edolisoma holopolium, Edolisoma sp., Lalage maculosa, L. niger, Malindangia sp. Discussion:* Delacour places *Tephrodornis* and *Hemipus* here, but the former agrees on every point with the Prionopinae, extending the range of this group into the Oriental region; the latter is a monarch flycatcher. *Function:* The advanced *M3a* increases the strength of palatal retraction in this group as in the assemblage.

WAXWINGS, SILKY FLYCATCHERS, PALM CHATS (BOMBYCILLIDAE).—*Diagnosis:* Muscle pattern (figure 4) similar to that of the Campephagidae but *M7c* pinnate and extended dorsally with gap between *M2* and *M6* as in the Pycnonotinae. Bill notched, short and broad, non-operculate, with rictal bristles. Tongue as in the Campephagidae (*Phainopepla* with papillate surface like *Pycnonotus finlaysoni* and *Aeluroedus*). Palate of *Phainopepla* like that of the Campephagidae; palate of *Bombycilla* like that of the Pycnonotinae. Ten-primaried, fruit- and insect-eaters, mainly of the New World. *Species dissected: Bombycilla cedrorum, B. garrula, Dulus dominicus, Phainopepla nitens, Phainoptila melanoxantha, Ptilogonys cinereus, Hypocolius ampelinus. Discussion:* Despite the close similarity of Campephagidae and Bombycillidae, they are thought to have arisen from the Pycnonotinae independently by specialization of characters incipient in that group. Both groups have the lacrymal free, similar internal characters throughout, and plumage specialization with crests. An examination of Col. Meinertzhagen's specimen of *Hypocolius* clearly establishes its position in the Bombycillidae, and the fused lacrymal may indicate that it is a little closer to typical bulbuls than the other bombycillids. See Delacour and Amadon (1949).

THE OLD WORLD NECTAR-FEEDER ASSEMBLAGE.—The sunbirds, flower-peckers, and white-eyes share many internal characters with the Pycnonotinae, lacking only the gap between *M6* and *M2* characteristic of the Pycnonotinae. They could have arisen from the Sylviinae close to the bulbul stem; but the serrate-tipped mandibles of sunbirds and flower-peckers may be forecast in such a bulbul as *Andropadus*, and it is relatively easy to derive the plumage types of the whole assemblage from bulbuls. All have the ninth primary long and the tenth short, the ectethmoid truncate, lacrymal fused, and a large palatine salivary gland.

WHITE-EYES (ZOSTEROPIDAE).—*Diagnosis:* Muscle pattern (figure 7) similar to that of the Pycnonotinae, but protractors *M1* and *M2* expanded, *M6* suppressed, *M4b* split to accommodate a palatine sali-

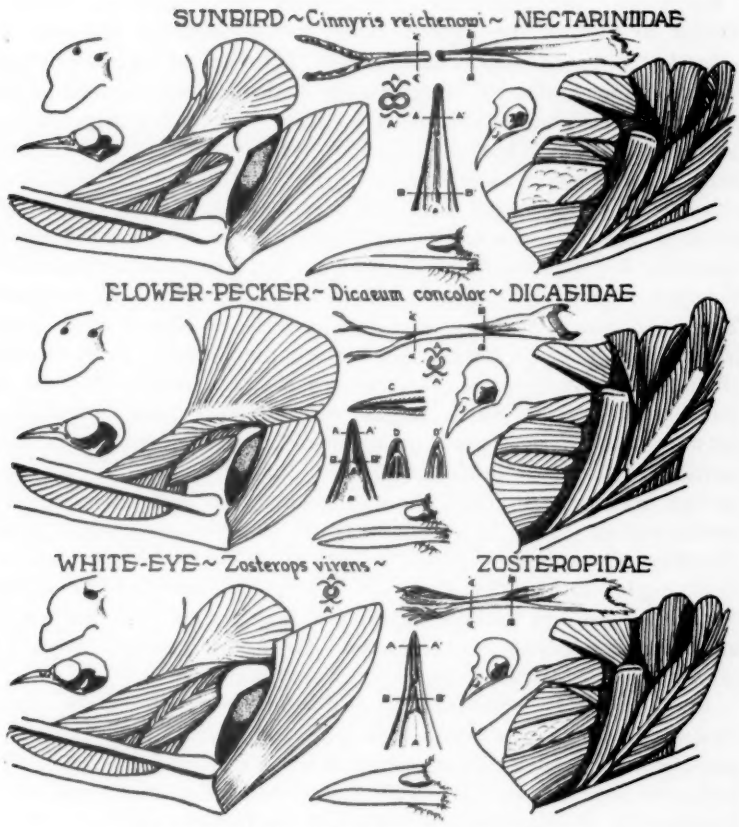

SUNBIRD ~ Cinnyris reichenowi ~ NECTARINIIDAE
FLOWER-PECKER ~ Dicaeum concolor ~ DICAEIDAE
WHITE-EYE ~ Zosterops virens ~
ZOSTEROPIDAE

FIGURE 7. Characters in sylvioid nectar-feeders.

vary gland visible in the floor of the orbit. Ectethmoid foramen single. Bill slender, essentially un-notched, operculate, with rictal bristles. Palate similar to that of a sylviid or bulbul; tongue unspecialized, but that of *Zosterops virens* whipped out into quadrifid tip and tubular. Nine-primaried (tenth vestigial) insect- and nectar-feeders of the Old World. *Species dissected: Zosterops japonica, Z. lateralis, Z. palpebrosa, Z. virens. Discussion:* Regarding the pycnonotine origin, the bulbul *Phyllastrephus zosterops* resembles white-eyes in plumage. *Function:* Anatomically, white-eyes are nothing but warblers (or bulbuls) adapted for nectar-feeding by the expanded *M1* and *M2*, the loss of the bill-notch and rictal bristles, and the sometimes specialized tongue, which functions as described for the Irenini.

SUNBIRDS (NECTARINIIDAE).—*Diagnosis:* Muscle pattern (figure 7) imilar to that of the Pycnonotinae, but protractors *M1* and *M2* expanded and inner slip of *M6* longer. Ectethmoid foramen double. Bill un-notched, slender, usually long, and decurved, serrate at tip, operculate, without rictal bristles. Palate with central ridge set in a groove and a raised boss far posterior. Tongue flat posteriorly with twin tubes separate anteriorly but fusing in the mid-portion. Ten-primaried (tenth short) nectar-feeders mainly of the Old World tropics. *Species dissected: Aethopyga gangliae, A. nipalensis, A. siparaja, Anthreptes collaris, A. malaccensis, Chalcoparia singalensis, Cinnyris jugularis, C. olivacea, C. oseus, C. reichenowi. Discussion:* The small size of sunbirds does not preclude derivation from larger bulbul-like ancestors, for size is adaptive; on the other hand the nest of the primitive sunbird *Arachnothera* suggests relationship to the warbler *Orthotomus* which has a "pinched" foramen intermediate between the single foramen of warblers and the double foramen of sunbirds. But the double foramen in sunbirds is matched in many groups diverging from the stem warblers. On such fine points of derivation we cannot be sure, and figure 18 expresses my best guess. *Function:* The expansion of protractors *M1* and *M2* indicates their use in prying into nectaries of flowers. The tongue functions as described for the Irenini, but the dorsal fusion of the twin tubes makes it more efficient. See revision by Delacour (1944) for tongue variants in *Arachnothera* and *Aethopyga*.

FLOWER-PECKERS (DICAEIDAE).—*Diagnosis:* Muscle pattern (figure 7) similar to that of sunbirds, but temporal slip of adductor *M7a* expanded and *M3a* advanced—protractors *M1* and *M2* reduced. Ectethmoid foramen double. Bill un-notched with finely serrate tip (notched in *Pardalotus*), operculate, without rictal bristles. Palate with central and posterior ridges fused. Tongue similar to that of sunbirds, but twin tubes each bifid terminally and not fused medially. Nine-primaried (tenth vestigial) fruit- and insect-eaters of the Australian and Oriental regions. *Species dissected: Dicaeum aeneum, D. concolor, D. cruentatum, Melanocharis versteri. Discussion:* The sunbirds and flower-peckers seem to have diverged from a common stock, the former as nectar-feeders with increased protraction, the latter as berry-eaters (mistletoe), with stronger adduction, but with above-average protraction for secondary nectar-feeding. *Function:* The tongue functions as in the Irenini, but the central palatal ridge has a sharp elevation (C), and the pattern of the tip of the upper mandible (D) is matched by that of the lower (D′). The serrate bill-tip, probably adapted for fruit-grasping, may be forecast in the multiple

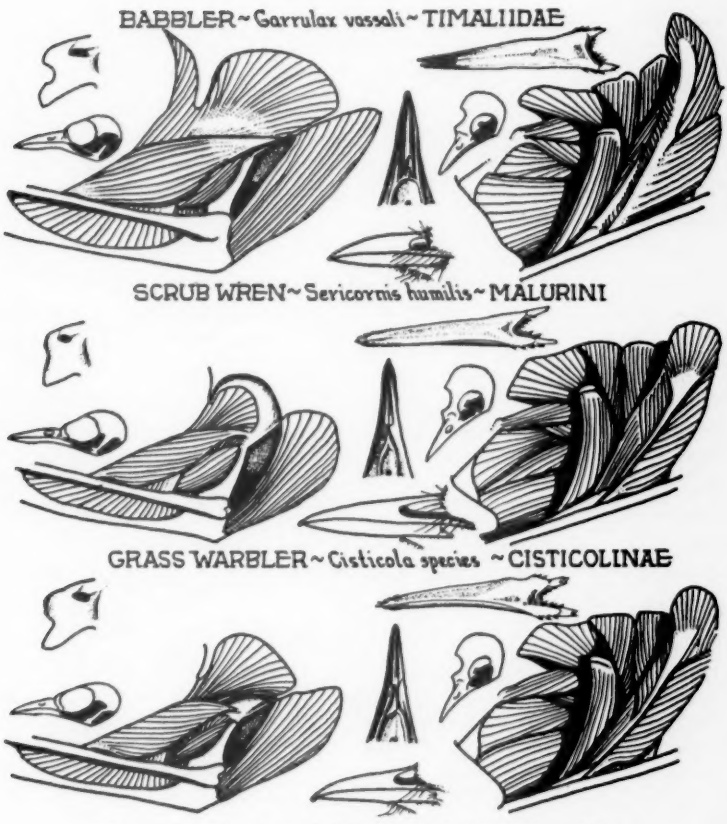


FIGURE 8. Characters in babblers and timalioid warblers.

bill-notches of the bulbul *Andropadus*. Revision by Mayr and Amadon (1947).

THE SUPERFAMILY TIMALIOIDEA

The Timalioidea form the larger of the two major divisions of the Oscines (figure 18). In the basic stock of this group, the capacity to evolve a pinnate *M7b* has permitted the development of shrike- and finch-like groups; the lack of this capacity apparently prevented the Sylvioidea from evolving similarly adapted forms. Two plumage types dominate this superfamily. One is a pattern of shaft-streaks, particularly on head and back. The other is a bold recognition pattern consisting of a black breast-crescent, auriculars, and crown, set off by light throat, forehead, and malar and superciliary regions.

This is evident in virtually all timalioid families, though often present only in part and sometimes apparently obliterated by extensive black or white. It is also found outside the Oscines, but within the suborder it is almost confined to the Timalioidea, only wheatears and jays among Sylvioidea showing it.

To trace timalioid origins, it is now necessary to return to the stem Sylviidae where warblers of the subfamily Cisticolinae exhibit pinnate *M7b* in its most primitive expression.

GRASS AND BUSH WARBLERS (CISTICOLINAE).—*Diagnosis:* Muscle pattern, etc. (figure 8) similar to that of the Sylviinae but *M7b* pinnate. Bill slender, notched, operculate, with rictal bristles. Ectethmoid winged, lacrymal fused. Tongue and palate similar to those of the Sylviinae but lateral ridges crowding center ridge posteriorly. Ten-primaried Old World insect-eaters. *Species dissected: Bradypterus castaneus, Cisticola galactotes, Cisticola sp., Horeites canturiens, Horornis montana, Locustella ochotensis, Megalurulus mariei, Megalurus palustris, Pnoepyga pusilla, Prinia atrogularis, Schoenicola brevirostris. Discussion:* This subfamily of the stem Sylviidae seems to be a key group from which the timalioid families all arise. The dark breast crescent of *Prinia flavicans* may foreshadow the recognition pattern mentioned above; *Cisticola* typifies the shaft-streak pattern. Revisions in part by Lynes (1930) and Delacour (1942–1943).

GRASS AND BUSH WARBLERS (MALURINI).—*Diagnosis:* Muscle pattern (figure 8) like that of the Cisticolinae but *M4b* tending to split into two slips. Ectethmoid plate truncate and falling short of zygoma as in true wrens. Tongue and bill similar to those of the Cisticolinae but nostril more broadly operculate. Palate with lateral ridges disappearing posteriorly. Ten-primaried Australian region insect-eaters, some with plumage specialization. *Species dissected: Amaurodryas vittata, Calamanthus fuliginosus, Gerygone magnirostris, Gerygone sp., Lamprolia victoriae, Malurus cyanea, Petroica multicolor, Petroica sp., Sericornis humilis, Stipiturus malacurus, Todopsis sp., Vitia ruficapilla. Discussion:* The colorful *Lamprolia* is definitely not related to the birds of paradise. The outer slip of *M6* is longer than the inner slip in *Vitia* and *Lamprolia* of Fiji; this suggests the origin of the latter from the former. *Todopsis* has the tip of the bill broadened.

MONARCHS, WHISTLERS, DRONGOS, AND VIREOS (MONARCHIDAE).—Internal characters are the basis for uniting these rather distinct shrike-flycatcher groups in a new family, the Monarchidae. All have, in common with Cisticolinae, a winged ectethmoid, a large, single foramen, fused lacrymal, and a prominent post-orbital process, but in their specialized bills show an advance over that group.

MONARCH FLYCATCHERS (MONARCHINAE).—*Diagnosis:* Muscle pattern (figure 9) similar to that of the Cisticolinae (but *M6* becoming trifid and pinnate in *Terpsiphone*). *M4a* with narrow anterior insertion on the slender transpalatine process.

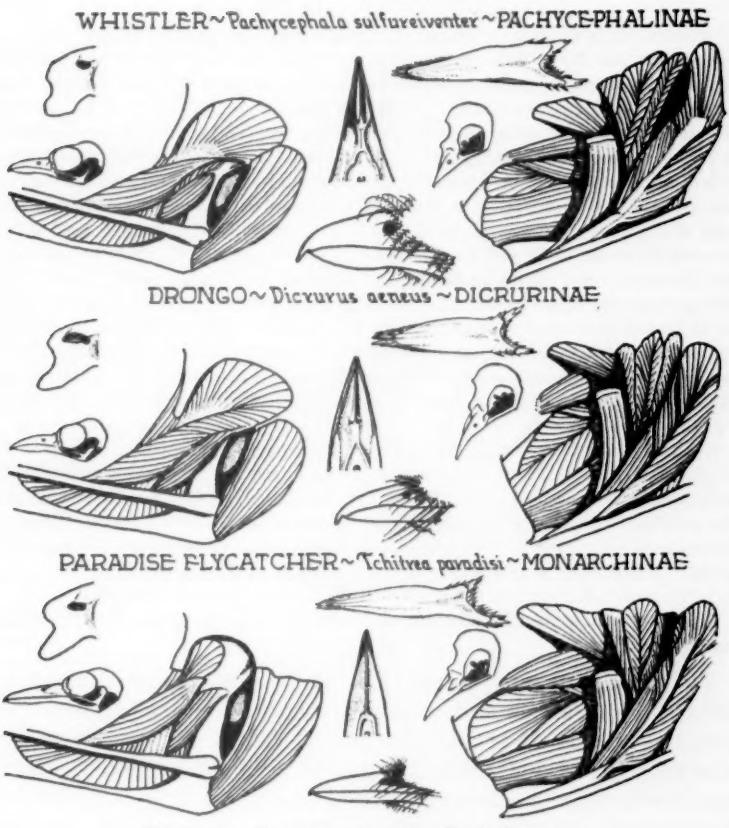


FIGURE 9. Characters in shrike-flycatchers.

Bill notched, broad and flat, semi-operculate to operculate, with nasal and rictal bristles. Posterior palatal ridge separated from anterior ridge only by the paired palatal nares. Tongue with prominent horny papillae posteriorly and quadrifid tip. Ten-primaried Old World shrike-flycatchers with plumage specialization culminating in the paradise flycatchers. *Species dissected: Batis poensis, Chasiempis gayi, Diaphorophyia castanea, Hemipus picatus, Hypothymis azurea, Lanioturdus torquatus, Monarcha castaneiventris, Myiagra ferrocyanea, Piezorhynchus sp., Platysteira cyanea, Rhipidura albicollis, R. cockerelli, R. leucophrys, Terpsiphone paradisi, T. rufiventris. Discussion:* As in the Malurini, a tendency for *M4b* to split with fusion of the lateral slip to *M4a* is seen in *Batis, Lanioturdus,* and *Platysteira*. But the small postorbital process and truncate ectethmoid with a small foramen in the Malurini, contrasted with the large process and "winged" ectethmoid with large foramen in the Monarchinae, suggest common cisticoline origin rather than direct relationship. These bony characters also distinguish the narrow-billed monarchs from the Malurini. The Monarchinae differ from the Muscicapinae also in having unspotted young and in behaving less like flycatchers and more like arboreal insect-gleaners (Delacour, 1947).

DRONGOS (DICRURINAE).—*Diagnosis:* Muscle pattern (figure 9) similar to that of *Terpsiphone*, but *M4a*, *M4b*, and the slips of *M7* fused (cf. monarchs); the temporal slip of *M7a* expanded. Bill notched, non-operculate with strong rictal and nasal bristles. Palatal pattern similar to that of the Monarchinae but more vaulted. Tongue similar to that of the monarchs but with a tendency for the horny papillae to be double-ranked. Ten-primaried (mainly black) Old World insect- and nectar-feeders with notable plumage specialization. *Species dissected: Dicrurus aeneus, D. balicasseus, D. coerulescens, D. hottentottus, D. sumatrana. Discussion:* Internal anatomy and plumage leave little doubt that this is a specialized group arising from the monarch flycatchers. *D. balicasseus* has a white belly like that of *Myiagra cyanoleuca*, and *Monarcha alecto* closely resembles unspecialized forms of *Dicrurus* in both black plumage and characters in the bill. *Function:* In *D. hottentottus*, the adaptive loss of the bill-notch and the nectar-adapted tongue indicate a strong approach to flower-feeding, though the persistence of rictal bristles suggests that insect-eating is still paramount. The similar quadrifid tongue-tips in this species and in the Meliphagidae suggest a common origin from the same timalioid stock. Revision by Vaurie (1949).

WHISTLERS (PACHYCEPHALINAE).—*Diagnosis:* Muscle pattern (figure 9) as in the drongos but without fusion. Palate and bill similar to those of drongos, but the latter always notched. Tongue also similar, but without double-ranking of papillae. Ten-primaried shrike-flycatchers of the Australian Region. *Species dissected: Colluricincla rectirostris, Pachycephala pectoralis, P. sulfureiventer, Pitohui ferrugineus. Discussion:* This appears to be a specialized Austro-malayan line arising from the monarch flycatchers and generally with a deeper, narrower bill.

VIREOS (VIREONINAE).—Treated below under the American nine-primaried assemblage.

THE SHRIKE ASSEMBLAGE.—The world-wide, insectivorous Monarchidae may have existed before the origin of flowering plants. The primitive shrike groups of the several faunal regions, apparently stemming from it independently and with differential emphasis on its variations, suggest a Tethyan Upper Cretaceous or Eocene distribution pattern (see von Reichenbach, 1909). Anatomically, the Australian Cracticidae are close to the Vanginae of Madagascar and the Prionopinae of Africa and India (all having large postorbital processes), as well as to the Bornean Bald Shrike (*Pityriasis*). A separate and later origin of the Laniidae from the Monarchinae is suggested by their more advanced muscle pattern (pinnate adductors) and reduced postorbital processes. The members of the shrike assemblage, except the Laniinae, have the ectethmoid winged, free lacrymal, and a single foramen.

THE WOOD SWALLOWS, BUTCHER BIRDS, BALD SHRIKES, AND MAGPIE LARKS (CRACTICIDAE).—These four subfamilies are apparently the result of adaptive radiation from a single monarchine stock, mainly in Australia. The radiation of the Vangidae on Madagascar is a parallel example. Internal characters and the black-and-white plumage patterns unite the groups, even though the Artaminae are long-winged

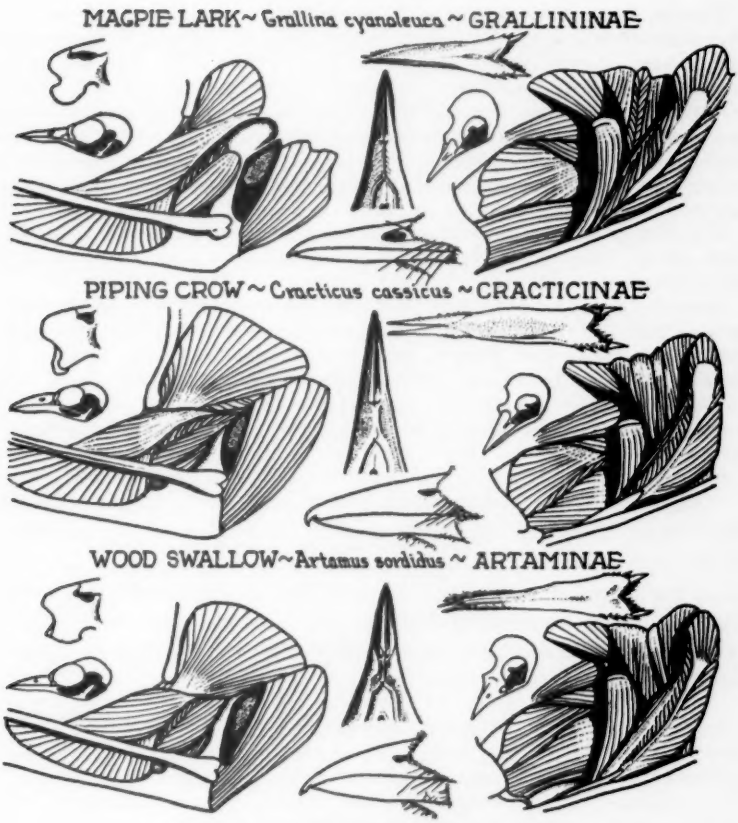

MAGPIE-LARK ~ Grallina cyanoleuca ~ GRALLININAE
PIPING CROW ~ Cracticus cassicus ~ CRACTICINAE
WOOD SWALLOW ~ Artamus sordidus ~ ARTAMINAE

FIGURE 10. Characters in Australian shrikes.

fly-catchers, the Cracticinae and Pityriasidinae are shrike-like, and the Grallininae are ground insect-eaters.

WOOD SWALLOWS (ARTAMINAE).—*Diagnosis:* Muscle pattern (figure 10) similar to that of the Monarchinae, but *M6* trifid (not pinnate), ensheathed in an aponeurosis, with special development of the temporal slip of *M7a; M4a* and *M4b* tending to fuse (cf. monarchs, drongos). Other internal characters similar to those of the Monarchinae but lacrymal free (vestigial?). Tongue and palate also similar, but bill stronger, nostril approaching the slit-like aperture of the Prionopinae. Ten-primaried, aerial insect-eaters of the Australian and Oriental regions. *Species dissected: Artamus leucorhynchus, A. sordidus. Discussion:* (See under Vanginae). *Function:* The length of *M3b* suggests powerful palate retraction, as already evident in Monarchinae, hence, an unusually good grip at the tips of the mandibles. The swallow-like wing with short tenth and very long ninth primaries, is adapted for soaring flight.

BUTCHER BIRDS (CRACTICINAE).—*Diagnosis:* Muscle pattern (figure 10) similar to that of the Artaminae but *M6* quadrifid and no fusion of *M4a* and *M4b*; free lacrymal stronger. Tongue, palate, and bill also resemble those of the Artaminae but bill has a distinct shrike-like hook. Ten-primaried Australian shrikes with rounded wings. *Species dissected: Cracticus cassicus, Gymnorhina tibicen. Discussion:* The musculature is more massive than that of the Artaminae, reflecting the different feeding habits which mark these distinct adaptive lines. *Function:* The bill of the butcher bird (*Cracticus*) is adapted for tearing impaled animals; *Gymnorhina* does not feed in this manner.

BALD SHRIKE (PITYRIASIDINAE).—*Diagnosis:* Internally similar to the Cracticinae, these groups probably having a common monarchine origin. *Species dissected: Pityriasis gymnocephalus.*

MAGPIE LARKS AND MUD-NEST BUILDERS (GRALLININAE).—*Diagnosis:* Muscle pattern (figure 10) closer to that of *Terpsiphone* than to that of the other Cracticidae; but tongue, palate, and plumage support their inclusion in this family. (See Amadon, 1950a.) *Species dissected: Grallina cyanoleuca, Struthidea cinerea. Discussion:* The fused lacrymal may be an adaptation for lateral vision characteristic of some ground feeders, and the reduction in *M3b* with a trifid pinnate *M6* may be similarly explained.

THE VANGAS AND HELMET SHRIKES (VANGIDAE).—The radiation of the vangas (Vanginae) in Madagascar has produced forms adapted for many niches in addition to the shrike-niche. Although clearly distinct from the helmet shrikes (Prionopinae) of Africa in jaw musculature and other internal characters, the Vanginae show unmistakable relationship with that group; and both may have stemmed independently from monarch ancestors.

VANGAS (VANGINAE).—*Diagnosis:* Muscle pattern (figure 11) similar to that of the Artaminae (cf. Pycraft, 1907). Bill notched, with rictal bristles (except in *Falculea*); nostril non-operculate, feathered. Palate and tongue similar to those of the Artaminae and Monarchinae. Ten-primaried insect-eaters, confined to Madagascar. *Species dissected: Hypositta corallirostris, Schetba rufa, Tylas eduardi. Discussion: Tylas eduardi* appears to be a vangid; it is anatomically very far from the orioles or the bulbuls (Mayr and Amadon, 1951). *Hypositta* differs from typical vangids only in having the lacrymal fused and is not close to Sittidae internally. *Mystacornis crossleyi* (dissected) may also be a vangid. As is typical for endemic Madagascar groups (Rand, 1936), the vangids appear to have radiated into many food-niches from a common ancestral stock. *Function:* The species examined have a long *M3b*, suggesting strong palatal retraction as in the Artaminae, but *Schetba rufa* has a unique feature. In this species, the anterior end of the zygoma has a notch-like eminence dorsally (A)—buttressed by a similar one posteroventrally (B)—so that, when the palate is fully retracted and the tip of the mandible depressed in maximum adduction, this notch will fall in place behind the ethmoidal wing (C). Supposedly, the bird will thus be able to tear or to maintain a grip indefinitely with decreased muscular effort.

HELMET SHRIKES (PRIONOPINAE).—*Diagnosis:* Muscle pattern (figure 11) similar to that of the Vanginae but *M4a* and *M4b* not fused, the latter splitting into two slips in *Sigmodus* and *Tephrodornis*, but all three fused in *Prionops* (cf. monarchs, drongos).

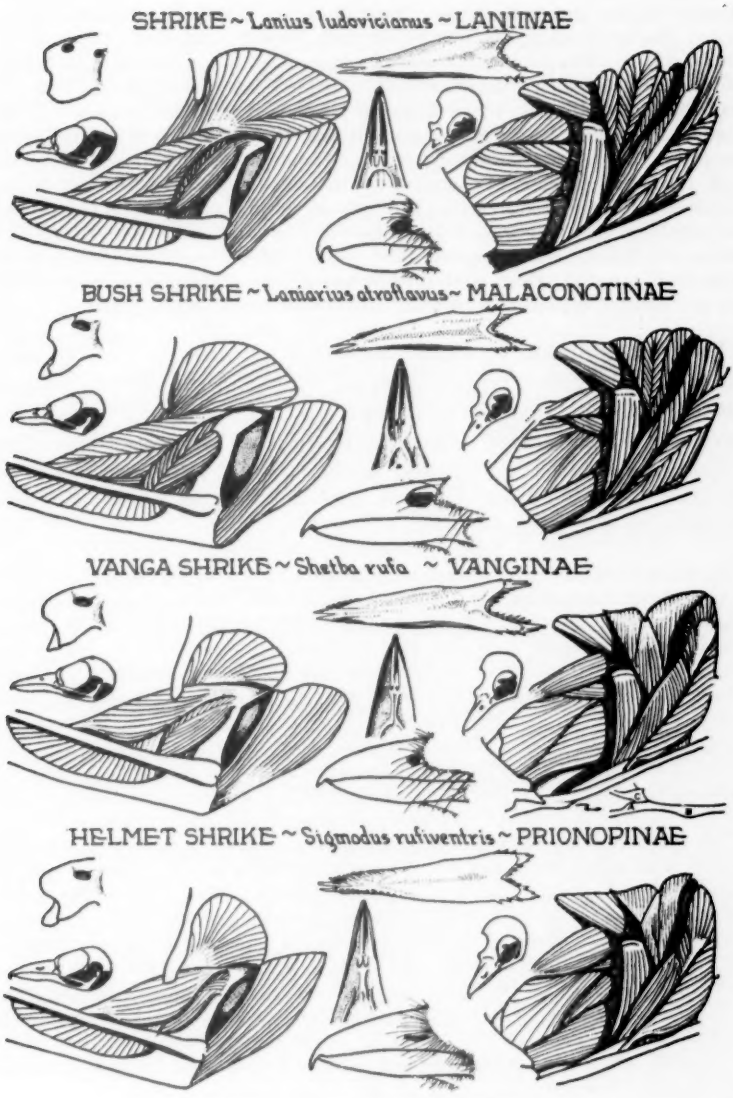

SHRIKE ~ Lanius ludovicianus ~ LANIINAE
BUSH SHRIKE ~ Laniarius atroflavus ~ MALACONOTINAE
VANGA SHRIKE ~ Shetba rufa ~ VANGINAE
HELMET SHRIKE ~ Sigmodus rufiventris ~ PRIONOPINAE

FIGURE 11. Characters in shrikes.

Tongue and palate similar to those of the Vanginae. Bill notched; rictal bristles present; slit-like nostril feathered. Ten-primaried African and Oriental insect-eaters. *Species dissected: Prionops poliocephala, Sigmodus rufiventris, Tephrodornis pondicerianus. Discussion: Tephrodornis* agrees with the Prionopinae in having pinnate *M7b*, split *M4b*, no advance in *M3a*, and free lacrymal—none of which ever occurs in cuckoo-shrikes, where Delacour has placed it. This extension of the range of this ancient African shrike group to the Oriental Region is not surprising. The early Tethyan distribution referred to above, which is *necessary* to explain shrike relationships, would have given the Prionopinae access to the Oriental Region (particularly southern India and Ceylon). Similarity of muscle pattern, bill, tongue, and palate (see figures) link the Prionopinae with the Vanginae and with the Pityriasidinae and Cracticidae. *Function:* In *Sigmodus, M3b* is even more strongly developed for powerful palatal retraction than in *Schetba*. This compensates for the lack of a notched zygoma as in *Schetba*. Review by Mayr (1943).

THE BUSH SHRIKES AND TRUE SHRIKES (LANIIDAE).—The Malaconotinae and Laniinae, ranging from the Ethiopian and Oriental regions into the Holarctic, may have arisen from the Monarchinae as a more successful shrike family that eliminated the less-advanced earlier shrikes (above) to a large extent in the Oriental Region. The more primitive shrikes appear to have survived best in sanctuaries like Australia and Madagascar.

BUSH SHRIKES (MALACONOTINAE).—*Diagnosis:* Muscle pattern (figure 11) similar to that of the Monarchinae, but the trifid *M6* and *M7a* pinnate (temporal slip expanded) without splitting or fusion in *M4*. Ectethmoid foramen single. Post-orbital process reduced, compared with the more primitive shrikes. Palate and tongue similar to those of the Monarchinae but nostril semi-operculate and rictal bristles reduced. Ten-primaried (mainly forest) shrikes of Africa. *Species dissected: Chaunonotus sabinei, Dryoscopus affinis, D. gambensis, Laniarius atroflavus, L. ferrugineus, Nicator chloris, Tchagra senegala. Discussion: Nicator* is atypical with *M6* trifid and parallel and *M7a* parallel, but it fits best here. It is not related to the Pycnonotinae (*contra* Delacour, 1943a) and resembles *Malaconotus* externally.

TRUE SHRIKES (LANIINAE).—*Diagnosis:* Muscle pattern (figure 11) similar to that of the Malaconotinae but more massive and with different structure in *M6*. Bill stouter, with strong hook; nostril non-operculate, feathered; rictal bristles present. Ectethmoid truncate, foramen double; lacrymal fused or lost. Palate and tongue similar to those of the bush shrikes but the post-orbital process further reduced. Ten-primaried shrikes of the Old and New Worlds. *Species dissected: Cephalophoneus nasutus, Lanius excubitor, L. ludovicianus, L. schach, Urolestes melanoleucus. Discussion:* In all shrikes the lateral slip of *M6* tends to be advanced in its insertion anteriorly on the inner surface of the mandibular ramus, and this is pronounced in *Cephalophoneus*. *Function:* The loss of the lacrymal and resulting shortness of the ectethmoid, which does not reach the zygoma, may permit better forward vision as in the Starling (*Sturnus*).

THE HONEY-EATER, WEAVER ASSEMBLAGE.—Many lines of evidence suggest that primitive honey-eaters, which had evolved an angulated commissure (prominent in nectar- and seed-adapted groups) but had

not yet lengthened the bill, were pre-adapted to evolve the weavers. *Aethorhynchus* (figure 12) is similar in muscle pattern to *Ploceus* (figure 12), and the two groups are similarly primitive in the large size often attained by the ectethmoid foramen. Palatal patterns are not far out of agreement, and plumage resemblances between the Australian honey-eaters and weavers may be significant. Some honey-eaters build domed nests, the dominant architectural form of weavers. There are parallel anatomical relationships between the nectar-feeders and finches of the nine-primaried American assemblage. In both of these cases the problem of deriving one specialized group from another is avoided by assuming that both come from a common unspecialized ancestor.

HONEY-EATERS (MELIPHAGIDAE).—Internal characters and the persistence of timalioid plumage patterns suggest a cisticoline origin for this timalioid family, though it is convergent with the Old World sylvioid group of nectar-feeders that may have displaced it from much of its former range. *Hylia* and *Pholidornis*, variously placed in the Ploceidae and Sylviidae, are unspecialized Meliphagids, wide-ranging in forested Africa. They may be combined with the specialized *Promerops* of the Cape region in the subfamily Promeropinae. This group is linked with the typical Australian subfamily (Meliphaginae), which it closely resembles, by the less specialized Oriental Aegithininae. All have the ectethmoid winged, foramen single, and lacrymal fused. The tongue is only weakly quadrifid in the Aegithininae.

AUSTRALIAN HONEY-EATERS (MELIPHAGINAE).—*Diagnosis:* Muscle pattern (figure 12) similar to that of the Cisticolinae in *Melidectes* and *Melipotes*, but *M7b* loses pinnate character in the typical, slender-billed forms. *M6* bifid (trifid and pinnate in *Philemon*), protractors *M1* and *M2* expanded. Bill un-notched, operculate, without rictal bristles. Tongue tubular, whipped out into long, quadrifid tip. Palate with central ridge often grooved and posterior ridge usually trifid. Ten-primaried nectar-feeders of the Australian Region. *Species dissected: Acrulocercus braccatus, Foulehaio carunculata, Melidectes fuscus, Meliphaga analoga, M. gracilis, M. versicolor, Melipotes gymnops, Myzanthe melanocephala, Myzomela cardinalis, M. melanocephala, M. sp., Philemon buceroides, Prosthemadera novaeseelandiae. Discussion:* The loss of the pinnate character of *M7b* in more typical meliphagids may be correlated with weaker adduction following stronger protraction (in *Acrulocercus*, *M2* crowds *M6* just as in starlings). Despite wide radiation in the Australian sanctuary, this subfamily was eliminated elsewhere. *Function: Philemon* (figured) is atypical, but its trifid *M6* (possibly quadrifid) suggests relationship to the Aegithininae and Estrildidae. In this and other specialized genera, vacuum for nectar-feeding is attained in a unique manner. The cross section A–A′ (also C) shows the grooved central ridge for closing the tubular section of the tongue, while pressure from the ridge of the lower mandible creates vacuum by a nibbling action observed in captive specimens. In *Melipotes* and *Prosthemadera* the central ridge is unspecialized. *Foulehaio, Myzomela, Prosthemadera*, and *Meliphaga* have *M4b* split to accommodate a large palatine salivary gland.

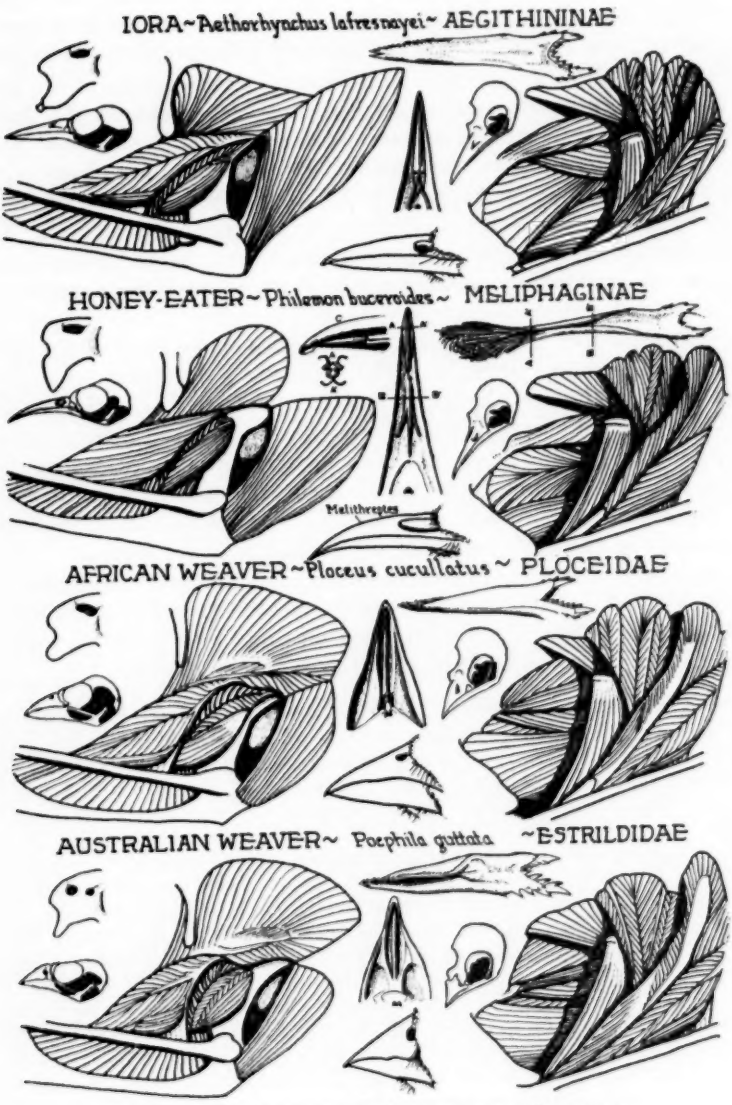


FIGURE 12. Characters in honey-eaters and weavers.

AFRICAN HONEY-EATERS (PROMEROPINAE).—*Diagnosis:* Muscle pattern of *Promerops* is similar to that of the Meliphaginae (*M7b* parallel, *M6* bifid); the shorter-billed *Hylia* and *Pholidornis* have *M7b* pinnate as in the short-billed *Melidectes* and *Melipotes*. *Promerops* has the meliphagine trifid palatal boss. Tongue tubular with quadrifid tip in *Promerops;* grooved with truncate, quadrifid tip in *Hylia*, similar in *Pholidornis*, but tip not clearly quadrifid. Bill un-notched, long in *Promerops*, short in the others; operculate; without rictal bristles. *Promerops* and *Pholidornis* have rigid, scaly crown feathers, suggested by those of some Ploceinae, especially *Sporopipes*. Ten-primaried African nectar-feeders. *Species dissected: Hylia prasina, Pholidornis rushiae, Promerops cafer. Discussion: Pholidornis* is West African, *Hylia* widespread, both in forest; *Promerops* is confined to the Cape Region in ecological association with *Protea* flowers. The first two build pendant, roofed nests; that of *Promerops* is nearly roofed. *Gliciphila modesta* (one of the Meliphaginae of New Guinea) builds a pendant, roofed nest (Rand, 1942; 357).

ORIENTAL HONEY-EATERS (AEGITHININAE).—*Diagnosis:* Muscle pattern and other internal features (figure 12) as above with pinnate *M7b* (also *M7a* in *Aethorhynchus*), but nostril semi-operculate. *Aegithina* and *Erpornis* have *M6* bifid; *Aethorhynchus*, trifid and pinnate (like *Philemon*). Ten-primaried insect- and nectar-feeders of the Oriental Region. *Species dissected: Aegithina tiphia, Aethorhynchus lafresnayi, Erpornis xantholeuca. Discussion:* This timalioid group is not related to the pycnonotine Irenini. Though less specialized than African and Australian meliphagids, the semi-operculate nostril is close to that of the Australian *Manorina*, and the long tip of the tongue in *Aegithina* and *Aethorhynchus* shows an incipient quadrifid character. The whipped-out tongue of *Erpornis* is not clearly quadrifid, and the species is included here only until it can be checked thoroughly; it may be a babbler. *Function: Aethorhynchus* has a small, free lacrymal probably associated with forward vision in this prying group. The palate approaches that of the Ploceidae. The survival of this group in competition with the Oriental sylvioid nectar-feeders may hinge on its lack of specialization; except for the specialized *Promerops*, the same may hold for the African group.

WEAVERS.—Internal characters seem to confirm what Chapin (1917) and Delacour (1943b) suspected, that the Australian weavers originated independently of the African weavers. The Estrildidae seem, in fact, to have arisen from the Meliphaginae or Cisticolinae in Australia, while the Ploceidae arose from the Promeropinae or Cisticolinae in Africa. I am unable, on anatomical grounds, to agree with Chapin that the Viduinae are a subfamily of the Estrildidae; they seem to be a subfamily of the Ploceidae, parasitic on such estrildids as reached Africa and radiated throughout its grasslands. Their inability to reach Australia and their poorness in species suggest a relatively late origin from the Ploceidae.

WAXBILLS, MANNIKINS, GRASSFINCHES (ESTRILDIDAE).—*Diagnosis:* Muscle pattern (figure 12) derivable from that of the Cisticolinae, but adductors *M6* (trifid) and *M7* pinnate; palatal retractors, expanded, with large *M4* and complex *M3b* (as in Turdidae). Ectethmoid foramen double, lacrymal fused. Bill un-notched, broadly conical

with nostril recessed below shield-like posterior border; rictal bristles virtually lacking. Tongue with ventral horn rolling inwards dorsally, frayed on sides and tip. Palate with lateral ridges compressed inward to fuse with central ridge, leaving posterolateral vaults. Ten-primaried Old World seed-eaters. *Species dissected: Estrilda angolensis, E. melpoda, E. nonnula, Lonchura castaneothorax, L. striata, Padda oryzivora, Parmoptila woodhousei, Pirenestes sanguineus, Poephila gouldiae, P. guttata, P. modesta, P. ruficauda, Pytilia afra, Sporopipes frontalis. Discussion:* The high origin of *M7* within the orbit and the trifid *M6* (quadrifid in the Ploceidae) are notable, as is the tendency for these adductors to have advanced insertions on the mandible. The double foramen, too, is not found in the Ploceidae. This group could logically have stemmed from the Cisticolinae. Both the Malurini and Estrildidae build similar domed nests in grass (neither woven nor pendant as in Ploceidae), lay similar eggs, and tend toward specialization in color of plumage—traits possibly reflecting a common ancestor. It is possible that the Australian weavers could have invaded Africa via Malaya because the grassland seed-niche there was open (the Ploceidae may have arisen as forest types); but the African grassland would not have been open to the Malurini because of competition with the Cisticolinae which were already there.

WEAVERBIRDS, WHYDAHS, ETC. (PLOCEIDAE).—*Diagnosis:* Muscle pattern (figure 12) similar to that of the Estrildidae, but *M6* quadrifid, *M7* shorter in both origin and insertion, and ectethmoid foramen single. Tongue not rolled and only the tip frayed out. Palatal ridges not fused and without posterolateral vaults. Bill un-notched without shield, semi-operculate, virtually without rictal bristles. Ten-primaried seed- and insect-eaters of the Ethiopian, Oriental, and Palaearctic regions. *Species dissected:* (Ploceinae) *Euplectes orix, E. progne, Malimbus nitens, M. sp., Ploceus bicolor, P. cucullatus, P. reichenowi;* (Viduinae) *Steganura paradisea, Vidua macroura, V. regia;* (Passerinae) *Dinemellia dinemelli, Passer domesticus, P. griseus. Discussion: Aethorhynchus* (Aegithininae) resembles the Ploceinae internally and externally, but each is considered a separate offshoot from the Cisticolinae. The internal (see *Diagnosis*) and external similarities suggest that the whydahs, etc. (Viduinae) have arisen from weavers (Ploceinae); in both there is an eclipse plumage, and young do not breed until the second year. The Viduinae are specific parasites of waxbills (Estrildidae), their young imitating those of that group in the marking of the mouth. *Anomalospiza* may belong to this group (Bannerman, 1949), its parasitization of members of the Cisticolinae paralleling that of some primitive neotropical cowbirds (Icteridae)

which usually parasitize close relatives (Friedmann, 1929). ***Dinemellia*** is included in the subfamily Passerinae as a specialized rather than a primitive form, but this "lumping" may not be justified. Too few species have been dissected to consider seriously a detailed rearrangement of this complex group. The finely-woven retort-shaped nests of the Ploceinae may be an evolutionary elaboration on the clumsily-woven nests of *Cisticola*, that of *C. juncidis* approaching the retort shape. *Function:* Many weavers, particularly forest-dwellers, have weaker bills than the typical seed-eating forms.

THE AMERICAN NINE-PRIMARIED ASSEMBLAGE.—It seems particularly clear that the American nine-primaried families arose from the vireos (Vireoninae), a subfamily of the Monarchidae. On anatomical grounds, these primitive shrike-flycatchers appear to have given rise to insect-eating wood warblers (Parulinae) and fruit-eating tanagers (Thraupinae). The buntings (Emberizinae) apparently evolved from the Parulinae, and in turn gave rise to the blackbirds (Icteridae) and Galapagos finches (Geospizidae). The finches of the Pyrrhuloxiinae and Carduelinae and, on Hawaii, the highly adapted Drepanididae, apparently evolved from the tanagers. In addition, both warblers and tanagers independently produced nectar-feeders (Beecher, 1951b). Formerly these were included in a single family, the Coerebidae. Evidently the families of this assemblage radiated to fill the food-niches provided by flowering plants in the New World. The ecteth-moid is usually winged, lacrymal fused, the single foramen becoming double in Parulidae.

VIREOS (VIREONINAE).—*Diagnosis:* Muscle pattern (figure 13) similar to that of the Monarchinae, but *M6* trifid, *M7a* with temporal slip pinnate, *M7b* parallel (except in *Vireo altiloquus* and *V. olivaceus*). Ectethmoid foramen large, single; lacrymal fused. Bill notched, semi-operculate with nasal and rictal bristles. Palate similar to that of the Monarchinae, tongue with bifid tip. Ten-primaried (tenth variable, ninth often long) insect-eaters of the New World. *Species dissected: Hylophilus decurtatus, H. hypoxanthus, H. olivaceus, H. poicilotis, Vireo altiloquus, V. flavifrons, V. griseus, V. olivaceus. Discussion:* Internal characters relate the vireos to the Monarchidae, but both these shrike-flycatcher groups are similar in behavior. Some monarchs occasionally nest in a horizontal fork like vireos. Plumage resemblances are less convincing; but the vireos have evidently been isolated from monarchs throughout the Tertiary, so close external resemblance cannot be expected. *M7b* is pinnate in only two species of vireos, but it is strongly pinnate in the Cyclarhini, which are strongly shrike-like. It is also pinnate in the Parulinae. The advance of *M3a* on the mediopalatine clasp is an assemblage character. *Hylophilus poicilotis* with pinnate *M6*, *M1*, and *M2* and un-notched bill is adapted to nectar-feeding, but its muscle pattern approaches that of the Cyclarhini.

SHRIKE-VIREOS (CYCLARHINI).—*Diagnosis:* Muscle pattern (figure 13) similar to that of *Hylophilus poicilotis* and *Vireo* but muscles more massive, *M1*, *M6*, and *M7* (including *M7b*) fully pinnate. Bill shrike-like; and horny palate relatively short,

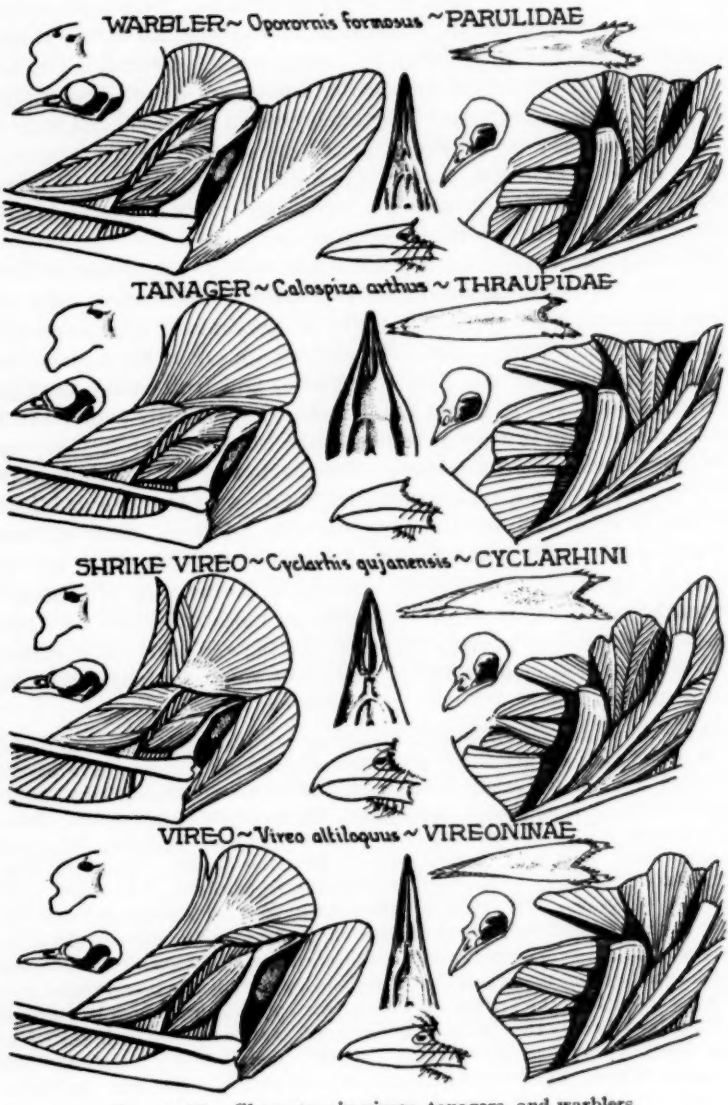

WARBLER~ Oporornis formosus ~PARULIDAE
TANAGER ~ Calospiza arthus ~ THRAUPIDAE
SHRIKE VIREO~Cyclarhis gujanensis ~ CYCLARHINI
VIREO~Vireo altiloquus ~ VIREONINAE

FIGURE 13. Characters in vireos, tanagers, and warblers.

narrow, and deep. *Species dissected: Cyclarhis gujanensis, Smaragdolanius pulchellus. Discussion:* This is a strongly shrike-like Neotropical group whose resemblance to the parallel Old World pachycephaline *Falcunculus* was shown by Naumburg (1925). It presumably includes *Vireolanius*. *Function:* Adductors and palatal retractors strongly developed as in other shrikes, but details betray vireo origin.

WARBLERS, BUNTINGS, ETC. (PARULIDAE).—The efficiency of the warblers in occupying insect-, fruit-, and nectar-niches is further reflected in the origin of the buntings from them; and in turn, the evolution of the adaptable blackbirds and Galapagos finches from the buntings.

WOOD WARBLERS (PARULINAE).—*Diagnosis:* Muscle pattern (figure 13) similar to that of the Cyclarhini, but less massive and *M3a* farther advanced. Ectethmoid foramen double or constricted; lacrymal fused. Bill un-notched (usually), narrow or broad, semi-operculate, with rictal and sometimes nasal bristles. Palate with conspicuous posterior ridge, lateral ridges disappearing posteriorly. Tongue with bifid tip. Nine-primaried (tenth small, rotated dorsally) insect- and nectar-feeders of the New World. *Species dissected: Basileuterus leucoblepharus, Dendroica aestiva, D. coronata, D. discolor, D. fusca, D. palmarum, D. pensylvanica, D. petechia, D. tigrina, D. virens, Geothlypis trichas, Granatellus venustus, Icteria virens, Mniotilta varia, Myioborus brunneiceps, Oporornis formosus, O. philadelphia, Parula americana, P. pitiayumi, Protonotaria citrea, Seiurus aurocapillus, S. noveboracensis, Setophaga ruticilla, Wilsonia pusilla. Discussion:* Broad-billed flycatcher-warblers like *Setophaga, Myioborus,* and *Basileuterus* appear to be primitive with parallel *M7a* and strong rictal and nasal bristles—in all of which they recall monarchs. *Function:* Wood warblers are the most slender-billed oscines with fully pinnate adductors. The efficiency of the pinnate adductors has permitted the reduction in mass of both muscle and bone in the head region, and this, I think, is responsible for their adaptive success. Segregation into adaptive tribes, aside from the Coerebini, calls for further anatomical study.

WARBLER HONEY-CREEPERS (COEREBINI).—I have elsewhere (Beecher, 1951b) given reasons for sinking the family Coerebidae and dividing its members between the warblers and tanagers. The present tribe agrees with warblers in all internal and external characters. *Species dissected: Ateleodacnis leucogenys, Coereba flaveola, Conirostrum rufum. Function:* Protractors *M1* and *M2* are expanded, an adaptation for prying in flowers. The tip of the tongue is whipped out.

BUNTINGS (EMBERIZINAE).—*Diagnosis:* Muscle pattern (figure 14) similar to that of the Parulinae, but the insertion of the median slip of *M6* advanced on the mandible at the expense of pinnate *M7b*. Large *M4a* overlying *M4b*. Ectethmoid foramen double or constricted; lacrymal fused (except in *Phrygilus* and *Lophospingus*). Bill un-notched, conical, semi-operculate, with rictal bristles. Palate with parallel anterior and lateral ridges terminating in a posterior boss for occlusion with the tomia of the lower mandible. Tongue slender, tapering to a short, bifid tip. Nine-primaried seed- and insect-eaters of the New and Old Worlds. *Species dissected: Amaurospiza concolor, Ammodramus savannarum, Arremon flaviventris, Atlapetes pileatus, Calamospiza melanocorys, Calcarius lapponicus, Chondestes grammacus, Coryphospingus pileatus, Cyanocompsa cyanea, Emberiza flaviventris, Guiraca caerulea, Junco hyemalis, J. oregonus, Melospiza georgiana, M. lincolni, M. melodia, Oryzoborus angolensis, Passerculus sandwichensis, Passerella iliaca, Passerina amoena, P. ciris, P. cyanea, P.*

leclancheri, Phrygilus fruticeti, P. unicolor, Pipilo chlorura, P. erythrophthalmus, P. fuscus, P. ocai, Plectrophenax nivalis, Pooecetes gramineus, Poospiza erythrophrys, P. nigro-rufa, Spizella arborea, S. passerina, S. pusilla, Zonotrichia albicollis, Z. capensis, Z. coronata, Z. leucophrys. Discussion: The North American buntings examined are specialized, with the insertion of *M6* advanced and the exoccipital inflated—and all except *Spizella pusilla* and *S. passerina* (which may not be close to *S. arborea*) tend to have a long hind claw for scratching. A primitive Neotropical group, containing the genera *Coryphospingus, Passerina, Phrygilus,* and *Poospiza,* has *M6* not advanced (unlike figure 14), approaching the paruline pattern. The insertion of *M6* is somewhat advanced in *Arremon* and *Ammodramus* as in the Holarctic or Palaearctic genera *Calcarius, Emberiza,* and *Plectrophenax.* All of these are likewise primitive in having the exoccipital uninflated or but slightly inflated, and none scratch for food. The American blackbirds are believed to have arisen from primitive Andean types like *Phrygilus* with the insertion of *M6* not advanced, thus similar to that of the cowbirds. *Phrygilus* also has plumage patterns paralleling those of the Icteridae. The advanced insertion of *M6* may be an adaptation for cracking seeds against the central boss.

Probably related to these Andean types are the primitive, mainly black "sporophiline" finches (Beecher, MS) which seem to be convergent with the Pyrrhuloxiinae, especially in bill form. *Species dissected: Catamenia analis, Sporophila aurita, S. moreletti, S. nigro-rufa, Tiaris bicolor, T. canora, T. olivacea, Volatinia jacarini. Oryzoborus* and *Cyanocompsa* (probably part of this complex) have the insertion of *M6* advanced. In *Catamenia* and *Sporophila,* as well as in *Amaurospiza,* the insertion is slightly advanced. The palate and external features suggest that *Melanospiza richardsonii* may belong here and may have come from the same stock as the Geospizidae.

GALAPAGOS FINCHES (GEOSPIZIDAE).—*Diagnosis:* Muscle pattern (figure 14) as in *Phrygilus* with the insertion of *M6* not advanced, *M7b* pinnate. Slot-like ectethmoid foramen single or double, lacrymal fused. Bill narrow, massive to slender, semi-operculate, with rictal bristles reduced. Palate emberizine, but with slight relief; tongue emberizine. *Species dissected: Camarhynchus parvulus, C. prosthemelas, Certhidea salvini, Geospiza assimilis, G. conirostris, G. fortis, G. fratercula, G. scandens, G. strenua. Discussion:* In the palate and externally *Melanospiza richardsonii* (Santa Lucia) is similar to *Geospiza,* and both may have been derived from a widespread Caribbean form like *Tiaris.* The Pliocene Gulf Stream could have rafted the ancestor of *Geospiza* through the Panama Water Gap to the Galapagos almost as readily as it might be airborne. I agree with Sushkin (1925) that *Certhidea* is an insect-eating Galapagos finch rather than a warbler. Adaptive radiation also has produced the nectar-feeding *G. scandens,* insect-eating *Camarhynchus,* and fruit-eating *G. crassirostris.*

AMERICAN BLACKBIRDS (ICTERIDAE).—Muscle pattern (figure 14) similar to above and to Andean Emberizinae but *M7b* complexly pinnate (not shown in Beecher, 1951a). Ectethmoid foramen constricted; lacrymal fused (except in *Sturnella* and *Pezites*). Bill un-notched,

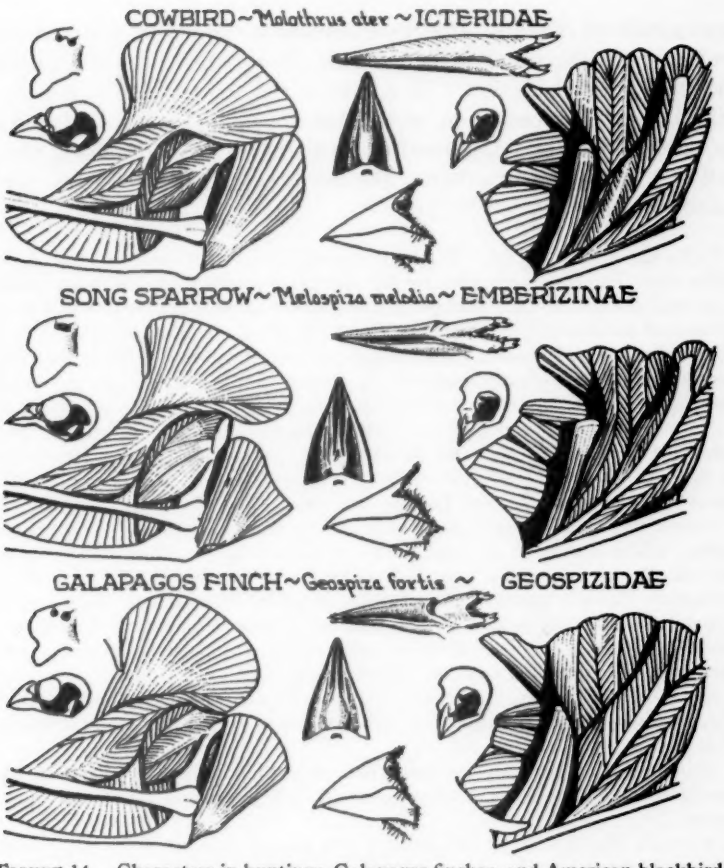


FIGURE 14. Characters in buntings, Galapagos finches, and American blackbirds.

conical to slender, semi-operculate (operculate in *Amblycercus*), generally without rictal bristles. Palate varying on emberizine pattern. Tongue similar to that of *Phrygilus* but often whipped out as an adaptation for flower-feeding (orioles, oropendolas, others). Nine-primaried New World seed-, fruit-, and insect-eaters. *All 38 genera* (including *Spiza*) *dissected. Discussion:* Bill un-notched, without rictal bristles, and the capacity to expand the protractors *M1* and *M2*, may have pre-adapted this group for radiation into virtually all the food-niches open to passerine birds in the New World.

TANAGERS, GROSBEAKS, SISKINS (THRAUPIDAE).—The tanagers seem to have arisen from vireos with parallel *M7b* and with specialization of plumage color similar to that noted in the Cyclarhini. Two

subfamilies of finches, the Pyrrhuloxiinae and the Carduelinae, evolved from the tanagers in the New World with little disjunction and in a parallel fashion. In addition, the tanagers gave rise to a tribe adapted for feeding on nectar (the Dacnini, formerly included in the Coerebidae) and apparently provided the ancestral stock which radiated in Hawaii to produce the nectar-, fruit-, insect-, and seed-eating drepanidids.

TANAGERS (THRAUPINAE).—*Diagnosis:* Muscle pattern (figure 13) similar to that of the vireos but *M6* always pinnate, *M7* (not *M7b*) progressively becoming pinnate in advanced forms so that *Tanagra* is close to the Carduelinae in this and in the advance of the insertion of the median slip of *M6* on the mandible (Beecher, 1951b). Bill notched, generally broad, with rictal bristles; nostril semi-operculate or feathered. Ectethmoid foramen usually single, lacrymal fused (free in some species of *Thraupis* and *Calospiza*). Palate with central ridge short, posterior ridge almost lacking, and lateral ridges continuous posteriorly. Tongue similar to that of the vireos. Nine-primaried New World fruit- and nectar-feeders. *Species dissected:* (unspecialized, as figured) *Calospiza arthus, C. chilensis, C. cyanoptera, C. desmaresti, C. guttata, Ramphocelus bresilius, R. carbo, Thraupis bonariensis, T. cyanocephalus, T. palmarum, T. virens;* (approaching Carduelinae with advancing insertion of *M6*) *Chlorophoneus cyanea, Habia gutturalis, H. rubica, Nesospingus speculiferus, Stephanophorus diadematus, Tanagra chlorotica;* (approaching Pyrrhuloxiinae with insertion of *M6* not advanced) *Cissopis leveriana, Hemispingus frontalis, Hemithraupis guira, H. sp., Spindalis zena. Discussion:* The variability of tanagers parallels that of wood warblers, reflecting enormous adaptive potential, but the heavier bills and musculature suggest the crushing function of fruit-eaters.

SWALLOW TANAGERS (TERSININI).—*Tersina viridis* is anatomically close to *Calospiza*, and is a broad-headed fruit-eater nesting in holes in the ground. I regard it as a tribe of the tanagers.

PLUSH-CAPPED TANAGERS (CATAMBLYRHYNCHINAE).—In the absence of anatomical specimens this group is tentatively presumed different enough to merit subfamily status.

TANAGER HONEY-EATERS (DACNINI).—This tanager element of the "Coerebidae" is treated here as a tribe, convergent with the warbler tribe Coerebini. *Species dissected: Chlorophanes spiza, Cyanerpes cyanea, Dacnis cayana, Diglossa plumbea, Euneornis campestris, Hemidacnis albiventris, Iridophanes pulcherrima. Function:* The generally longer, un-notched bills are adapted for probing deeper flowers than the bills of the Coerebini. Apparently this is done without prying, since *M1* and *M2* are weak.

CARDINAL GROSBEAKS (PYRRHULOXIINAE).—*Diagnosis:* Muscle pattern (figure 15) massive with *M1, M6,* and *M7* (not *M7b*) pinnate. Oval ectethmoid foramen single, lacrymal fused. Bill massive, un-notched, generally with rictal bristles; nostril non-operculate. Palatal ridges continuous posteriorly, tongue cylindrical. Nine-primaried New World seed-, fruit-, and bud-eaters. *Species dissected: Loxigilla violacea, Melopyrrha nigra, Pheucticus ludovicianus, P. melanocephalus, Pitylus grossus, Pyrrhuloxia cardinalis, P. sinuata, Saltator atriceps, S. atricollis. Discussion:* The first two species are here considered convergent with the sporophiline group (Emberizinae) but may really belong in that group. The grosbeaks emerge so gradually out of the variable tanagers that even anatomically it is difficult to draw a

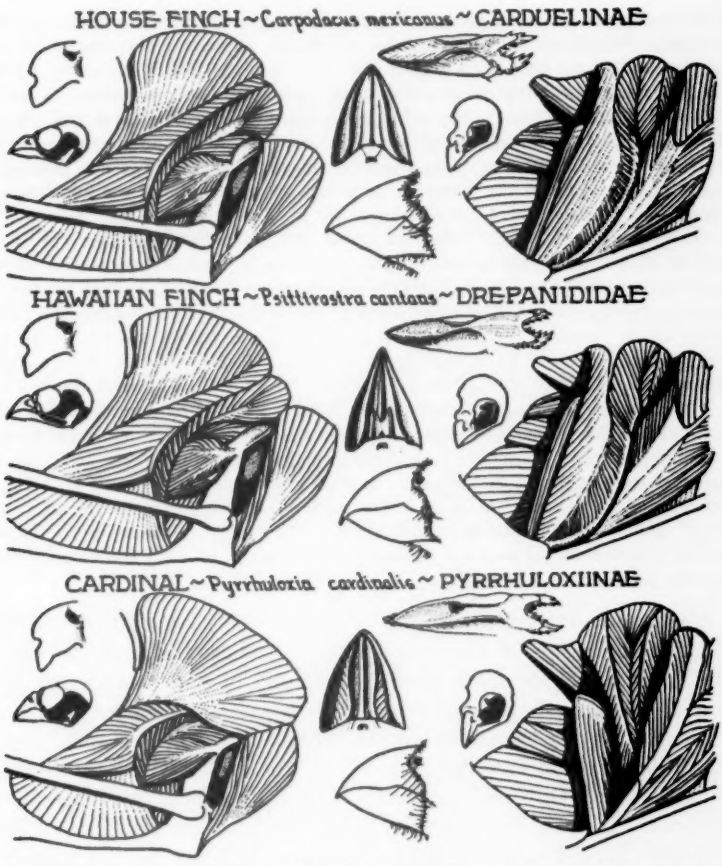

HOUSE FINCH ~ Carpodacus mexicanus ~ CARDUELINAE
HAWAIIAN FINCH ~ Psittirostra cantans ~ DREPANIDIDAE
CARDINAL ~ Pyrrhuloxia cardinalis ~ PYRRHULOXIINAE

FIGURE 15. Characters in pyrrhuloxine, cardueline, and drepanidine finches.

boundary line. I agree with Mayr and Amadon (1951) that *Richmondena* is congeneric with *Pyrrhuloxia*. *Function:* The massive bill and musculature are the culmination of the crushing function suggested in the tanagers.

LINNETS, SISKINS, ETC. (CARDUELINAE).—*Diagnosis:* Muscle pattern (figure 15) similar to that of the tanager *Stephanophorus; M1, M6,* and *M7* (not *M7b*) pinnate, insertion of massive median slip of *M6* advanced on the mandible. *M3b* complex as in the Turdidae. Single ectethmoid foramen slot-like, lacrymal fused. Bill un-notched, conical, with rictal bristles; nostril feathered. Palate as in the Pyrrhuloxiinae but with short ridges between the central and lateral ones posteriorly. Tongue cylindrical, its horny sheath with edges nearly meeting in the mid-line dorsally. Nine-primaried fruit-, bud-, and seed-eaters of the New and Old Worlds. *Species dissected: Carduelis carduelis, Carpodacus mexicanus, C. purpureus, Coccothraustes coccothraustes, Fringilla coelebs, Hesperiphona vespertina, Leucosticte griseonucha, Loxia leucoptera, Loximitris dominicensis, Pinicola enucleator, Pyrrhula*

pyrrhula, Spinus pinus, S. tristis. Discussion: Sushkin's (1925) recognition of the subfamily Fringillinae for the chaffinch (*Fringilla coelebs*) is not supported; the modification of the bony palate from the carduelinе pattern is the result of the enlarged palatine salivary gland probably in adaptation to more frugivorus habits. Mayr and Amadon's (1951) proposal to apply this name to the present group is not adopted because the term, Fringillidae, has been used for a polyphyletic family. Logically, it would be better to suppress the term and its root in formal taxonomic papers and to recognize the several finch groups as subfamilies of the warblers and tanagers as outlined above. I am not in favor of changes of family names on a purely nomenclatorial basis. Simpson (1945: 30) has pointed out that the International Rules do not call for observance of priority in forming supergeneric names. Had I constructed the names of the higher categories from type genera chosen by priority, the superfamily Timalioidea would become Passeroidea, the family Thraupidae would become Fringillidae, the subfamily Carduelinae would become Fringillinae. It would be impossible to use Monarchidae as a new family name, reducing older families to subordinate positions. Each of these changes would result in a name with confusing connotations and would serve no useful purpose whatever. In the case of the Monarchidae, taxonomy (so interpreted) would stand in the way of doing what must be done. I agree with Simpson that taxonomic principles for higher categories should be guided by general usage, common sense, and technical convenience. *Function:* The massive *Mó*, with its advanced insertion in all genera except *Loxia*, insures maximum adduction. The hawfinches have posterolateral palatal vaults occluding with the posterior part of the tomia of the lower mandible in a mortar-and-pestle function.

HAWAIIAN HONEYCREEPERS, FINCHES (DREPANIDIDAE).—From what has been said of the fruit-, nectar-, and seed-adapted groups of the Thraupidae, we might predict the result of uncontested colonization of the Hawaiian Islands by an unspecialized tanager similar to *Piranga*. At any time between the Eocene and Pliocene such an ancestral form could have been rafted by the Gulf Stream through the Panama Water Gap and carried to Hawaii, though it was more likely airborne. If the islands emerged in the Pliocene (Stearns, 1946), radiation into the food niches could presumably take place rapidly in the virtual absence of competition, the special bill forms of the nectar-feeders reflecting the peculiarities of the Hawaiian flora. A generalized tanager stock similar to *Piranga* could evolve in two directions. The bill could become lengthened to produce nectar-feeders and probers (the counterpart of the Dacnini) or thickened for feeding on seeds and buds (the counterpart of the Carduelinae). Amadon (1950b) divides the Drepanididae into two such groups.

HAWAIIAN FINCHES (PSITTIROSTRINAE).—*Diagnosis:* Muscle pattern (figure 15) like that of *Carpodacus*, but more massive. Other internal features also similar, but central palatal ridge short as in tanagers, rictal bristles further reduced. *Species dissected: Psittirostra cantans, P. psittacea. Discussion:* The striking similarity of the Hawaiian finches to the carduelinе finches in all but plumage suggests parallel development from isolated segments of the thraupine stock.

HAWAIIAN NECTAR-FEEDERS (DREPANIDINAE).—*Diagnosis:* Muscle pattern (Beecher, 1951b) like that of tanager nectar-feeders (Dacnini), but the longer, heavier bills and large *M1* and *M2* indicate prying. *Species dissected: Himatione sanguinea, Vestiaria coccinea. Discussion: Himatione* shows advanced insertion of the median slip of *M6* as in tanagers, a feature culminating in the condition in *Psittirostra.* I examined *Hemignathus lucidus* briefly and, without making direct comparison, thought it like *Himatione* and *Vestiaria.* But Amadon says it is close to *Psittirostra,* and I cannot say he is incorrect.

THE TIMALIID ASSEMBLAGE.—Although the term "assemblage" is usually applied to a group of families in this paper, it is here used to emphasize the adaptive potential of a single family. The existence of shrike-babblers, lark-babblers, and tit-babblers suggests the unprecedented number of adaptive "tribes" which evolved from it. These cannot be defined anatomically without dissecting many more species than exist in present spirit collections. The Timaliidae might be considered the stem group of the Timalioidea, since the Cisticolinae (somewhat more primitive) is a transitional group, as much a subfamily of this family as of Sylviidae. Revision by Delacour (1946).

BABBLERS (TIMALIIDAE).—*Diagnosis:* Muscle pattern (figure 8) similar to that of the Cisticolinae but outer slip of bifid *M6* longer than inner and *M7* with very high origin inside the orbit. Ectethmoid winged, foramen single, lacrymal fused. Bill notched, operculate or semi-operculate, with rictal bristles. Palate and tongue similar to those of the Cisticolinae. Ten-primaried Old World insect- and fruit-eaters. *Species dissected: Alcippe nipalensis, A. sp., Chrysomma sinensis, Cinclosoma ajax, Crateroscelis murinus, Daphoenositta miranda, Eupetes coerulescens, Garrulax leucolophus, G. vassali, Laniellus leucogrammicus, Leiothrix argentauris, Leioptila capistrata, Macronus rubricapilla, M. sp., Malia grata, Neomixis tenella, Orthonyx spinicauda, Pellorneum ignotum, P. tickelli, Picathartes oreas, Pomatorhinus montanus, Psophodes olivaceus, Siva cyanuroptera, S. strigula, Stachyris chrysaea, S. nigriceps, Turdinus brevicaudatus, T. crispifrons. Discussion: Picathartes* is unusual in its trifid pinnate *M6,* but I now agree with Delacour and Amadon (1951) as to its timaliine status. *Malia* clearly belongs here rather than with bulbuls or thrushes. *Cinclosoma* and *Eupetes* are slender-billed, narrow-skulled terrestrial forms with free lacrymal and, probably, forward vision; in them the pinnate character of *M7b* has virtually disappeared as it has in many honeyeaters and in the true wrens. *Leioptila capistrata,* reported by Deignan (1945) as investigating blossoms, has a tongue partially adapted to nectar-feeding. *Laniellus* of Java is a timaliine shrike; *Daphoenositta* of New Guinea is a timaliine tree creeper. Since the Laniidae and Sittidae are of timalioid origin, these attempts of Timalii-

dae to fill their niches in isolated regions are not strange. In fact it seems almost certain that many Australian forms which ornithologists have tried to link with groups occupying the same adaptive niche elsewhere (e. g. *Climacteris*, *Neositta*) are Timaliidae.

THE PIPIT, LARK, PARROT-BILL ASSEMBLAGE.—The pipits and larks seem to be parallel timalioid families arising from the Cisticolinae with the loss or reduction of the tenth primary and possessing plumage counterparts in the Monarchinae—a group of similar origin but different niche. *Alauda* and *Anthus* resemble *Cisticola* in their streaked pattern; *Eremophila* resembles *Motacilla*, *Rhipidura*, and *Platysteira* in recognition pattern. All four groups habitually wag or open and close the tail. The parrot-bills are basically similar to larks and pipits in muscle pattern, bill, palate, tongue, and (*Panurus*) reduction of the tenth primary. All have the ectethmoid winged, foramen single, and lacrymal fused.

PIPITS, WAGTAILS (MOTACILLIDAE).—*Diagnosis*: Muscle pattern (figure 16) similar to that of the Cisticolinae but *M6* becoming trifid, *M3a* advancing its insertion on the mediopalatine clasp, and the rather massive *M7* advancing its insertion on the mandible. Bill weak, slightly notched, with the culmen abruptly arched above the semi-operculate nostril; rictal bristles present. Palate similar to that of *Cisticola* but tongue trough-like, quadrifid at tip. Nine-primaried (ninth elongate) world-wide insect- and seed-eaters. *Species dissected: Anthus hodgsoni*, *A. pratensis*, *Motacilla alba*, *M. citreola*, *M. ocularis*. *Discussion: M. citreola* is very thin-billed, and its loss of pinnate character in *M7b* illustrates the same adaptive situation noted in Meliphagidae.

LARKS (ALAUDIDAE).—*Diagnosis:* Muscle pattern (figure 16) similar to that of the Motacillidae but *M6* bifid, *M3a* not advanced, *M4* and *M7* massive, the latter pinnate in all parts. Long postorbital process fused to suprameatic process. Bill un-notched, slender to conical with feathered nostril and rictal bristles. Palate as above but central ridge meeting posterior one in forms with a shorter bill. Tongue similar but with truncate, quadrifid tip. Ten-primaried (tenth reduced, ninth elongate) world-wide seed- and insect-eaters. *Species dissected: Alauda arvensis*, *Calandrella minor*, *Eremophila alpestris*, *Galerida cristata*, *Melanocorypha yeltoniensis*, *Mirafra assamicus*. *Discussion:* The larks seem to have originated from the Cisticolinae close to the pipits, monarchs, and parrot-bills. *Function:* Meinertzhagen (1951) observes that larks swallow seeds whole with grit, noting that the thick-billed *Rhamphocorys* does not have a very powerful "bite." Notably missing is the angulated commissure which in seed-cracking finches aligns the tomia or cutting edges of the bill

more nearly at right angles to the pull of the palatine retractors so that they can assist the adductors. The weakness of *M6* in larks is compensated for by the intrusion of massive *M7* into the orbit, and the fusion of the postorbital and suprameatic processes may simply provide greater surface for its origin. The peculiar, scutellated tarsus of this group is regarded as a unique specialization and not accorded much weight. Apparently some members (e. g. *Eremophila*) have lost the tenth primary.

WREN-TIT, PENDULINE TIT, PARROT-BILL (PARADOXORNITHIDAE).—Delacour's (1946) proposal that the Wren-tit (*Chamaea*) is close to the parrot-bills is supported by internal characters, but I prefer to recognize the Paradoxornithidae as a family rather than reduce the group to a tribe (Chamaeini) of the Timaliidae. It may be practicable to recognize two subfamilies—the Paradoxornithinae for the parrot-bills and wren-tit and the Aegithalinae for the Bush Tit (*Psaltriparus*) and the Penduline Tit (*Aegithalos*). (cf. Mayr and Amadon, 1951).

PARROT-BILLS (PARADOXORNITHINAE).—*Diagnosis:* Muscle pattern (figure 16) and other internal features similar to those of the Alaudidae, especially in *Suthora*, but post-orbital process short. Bill un-notched, thin in *Chamaea* to parrot-like in *Paradoxornis*, the curved upper mandible notably heavy, with rictal bristles; nostril non-operculate, feathered (*Chamaea* semi-operculate, unfeathered). Palate with anterior and posterior ridges separate in *Chamaea*, fused in parrot-bills, but the posterior ridge trifid posteriorly in all. Tongue long in *Chamaea*, short and truncate in parrot-bills but always quadrifid at tip. Ten-primaried Old World insect- and seed-eaters represented by *Chamaea* in the New World. *Species dissected: Chamaea fasciata, Panurus biarmicus, Paradoxornis unicolor, Suthora verreauxi. Discussion:* The generic variations are on a gradient, and there is no doubt of the homogeneity of the group. As in larks, a lack of angulation in the commissure might prevent evolution of a true finch type, and traces of the black recognition pattern in parrot-bills suggest relationship with larks. They may belong in the same assemblage, but are here regarded as distinct adaptive branches arising from the Cisticolinae. *Function:* the parrot-bills are ecologically associated with great reed beds, and the bill is used particularly for tearing reeds apart to obtain insects (Caldwell and Caldwell, 1931).

LONG-TAILED AND BUSH TITS (AEGITHALINAE).—*Diagnosis:* Similar to above but *M5* pinnate and *M3a* advancing its insertion on the mediopalatine clasp. *Species dissected: Aegithalos caudatus* and *Psaltriparus minimus. Discussion:* In the habit of building roofed, pendant nests, unlike the cup-shaped nests of the Paradoxornithinae, these birds apparently converge with the Remizinae of the true titmice.

WREN, CREEPER, TITMOUSE ASSEMBLAGE.—These families have the protractors *M1* and *M2* expanded for bill prying, and seem to stem from each other in the sequence: Troglodytidae—Certhiidae—Sittidae—Paridae. *M7b* might be considered parallel but not in the same sense as in Sylvioidea. In the wrens and creepers with their slender bills this muscle seems to be just at the point of entirely losing its pinnate character, as has occurred in slender-billed species of

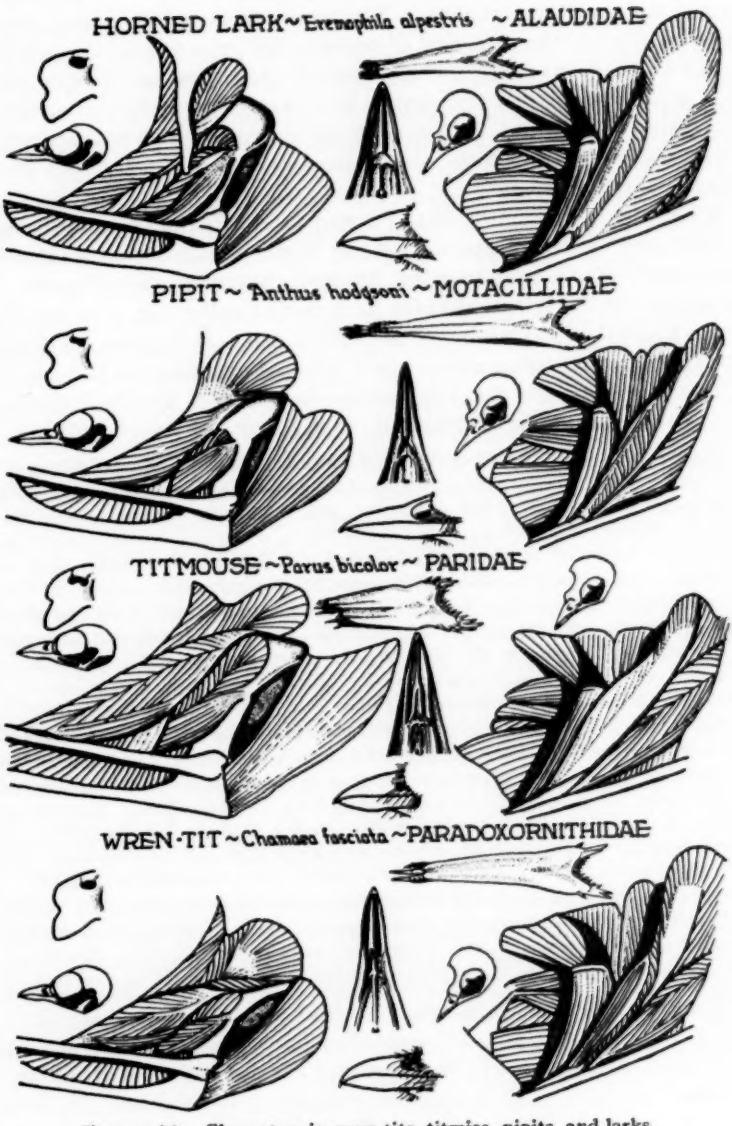

HORNED LARK ~ Eremophila alpestris ~ ALAUDIDAE
PIPIT ~ Anthus hodgsoni ~ MOTACILLIDAE
TITMOUSE ~ Parus bicolor ~ PARIDAE
WREN-TIT ~ Chamaea fasciata ~ PARADOXORNITHIDAE

FIGURE 16. Characters in wren-tits, titmice, pipits, and larks.

Timaliidae and Meliphagidae (below). If so, according to Dollo's Law (Gregory, 1936), power would need to be re-acquired in a different way in the derived thicker-billed Sittidae and Paridae. It happens that in members of these latter families the fibers of *M7b* insert on a broad aponeurosis that is apparently the functional equivalent of a pinnate *M7b*, possibly the substitution product of new gene loci. In designating this assemblage as timalioid, I have been influenced by the split *M4b* (never found in Sylvioidea), horny palate (as in the assemblage above), and timaliid plumage type. The nervousness and habit of carrying the tail over the back would be weak evidence alone but tend to support the verdict of the other characters—along with grassland, desert, and brush habitat—that Troglodytidae and Malurini (Australian wrens) arose independently from the Cisticolinae. Competition with these other groups in the Old World could have largely eliminated the Troglodytidae there, while the open niches of the New World could have permitted wide radiation. The families of this assemblage are primarily hole nesters or dome-nest builders.

WRENS (TROGLODYTIDAE).—*Diagnosis:* Muscle pattern (figure 17) similar to that of the Malurini but *M7b* not clearly pinnate. Ectethmoid plate truncate and falling short of zygoma as in Malurini; foramen single, lacrymal fused. Tongue slender, with quadrifid tip. Palate with slight vault between central and posterior ridges in *Troglodytes;* these ridges continuous in *Heleodytes*. Bill slender, generally un-notched, operculate, without rictal bristles. Ten-primaried insect-eaters of the New World and the northern parts of the Old World, with streaked or barred plumage. *Species dissected: Cistothorus stellaris, Heleodytes fasciatus, Telmatodytes palustris, Troglodytes aedon, T. musculus. Function:* Narrow interorbital distance, taken with the short ectethmoid and lack of rictal bristles, suggests unusual forward vision in wrens, which feed in close quarters where lateral vision as used in "rapid peering" may be ineffective.

CREEPERS (CERTHIIDAE).—*Diagnosis:* Muscle pattern (figure 17) similar to that of the wrens but greater expansion of protractors *M1* and *M2*. Other internal characters as in wrens. Bill similar but decurved, un-notched. Tongue still more slender than that of a wren, quadrifid. Palate with posterior ridge "open" but in many ways intermediate between that of the wrens and that of the titmice. Ten-primaried tree-creepers, mainly Holarctic, with streaked plumage. *Species dissected: Certhia familiaris. Discussion: Certhia* with its stiffened tail feathers is apparently the most specialized form. *Rhabdornis, Salpornis,* and *Tichodroma* are considered primitive members of the group, but *Climacteris* is believed to be an endemic Australian

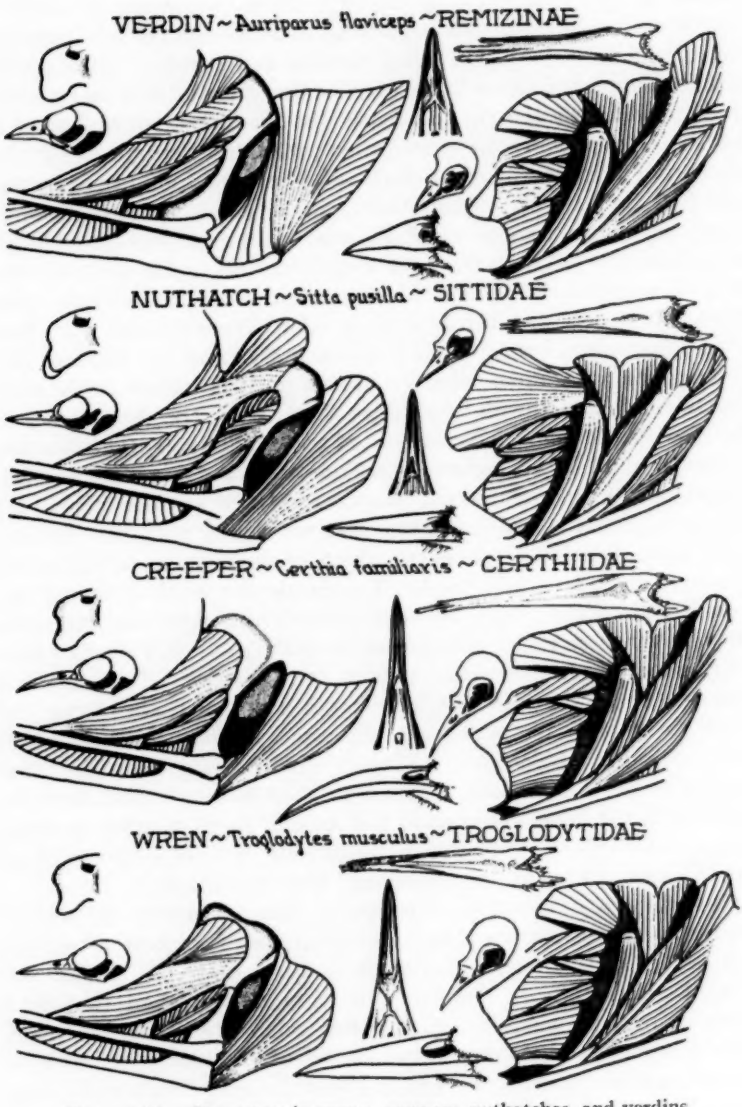

VERDIN ~ Auriparus flaviceps ~ REMIZINAE
NUTHATCH ~ Sitta pusilla ~ SITTIDAE
CREEPER ~ Certhia familiaris ~ CERTHIIDAE
WREN ~ Troglodytes musculus ~ TROGLODYTIDAE

FIGURE 17. Characters in wrens, creepers, nuthatches, and verdins.

timaliid genus. Muscle pattern, modifications for forward vision, slender bill, and plumage seem to link the creepers to the wrens, and the wall-creeper *Tichodroma* suggests a transition between creepers and nuthatches. *Function:* The slender bill seems to act as a curved forceps for probing bark-crannies "roofed" from the weather, and the prying musculature is probably as strong as the bill structure will stand.

NUTHATCHES (SITTIDAE).—*Diagnosis:* Muscle pattern (figure 17) advanced over that of the Certhiidae, with protractor *M1* partly pinnate and *M2* expanded over the interorbital septum, *M3b* slightly advanced, *M4a* enlarged, *M7* pinnate, except *M7b* which is covered by an aponeurosis. Other internal characters similar to those of the Certhiidae but lacrymal free, reaching zygoma, bill slightly recurved with rictal bristles; nostril non-operculate. Tongue quadrifid. Palate similar to that of the Paridae. Ten-primaried trunk-foraging birds of world-wide distribution. *Species dissected: Sitta canadensis, S. frontalis, S. pusilla. Discussion: Hypositta* (see above) seems to be a vangid; *Neositta* and *Daphoenositta* are believed endemic timaliid genera of the Australian region. Because of adaptive changes, it is not certain that this group stems from Certhiidae. The palate, tongue, and plumage in *Tichodroma* suggest at least a common stock. *Function:* In addition to its prying function, the enormous *M2*, so like that of woodpeckers, may oppose the advanced *M3b* to snub the palate from both directions for a shock-absorbing function in hammering. The free lacrymal reaches the zygoma but may be moved aside for clearer vision at the tip of the bill.

TITMICE (PARIDAE).—*Diagnosis:* Muscle pattern (figure 16) similar to that of the Sittidae but *M2* less expanded, adductors more massive. Ectethmoid truncate, foramen becoming double (pinched); lacrymal fused. Bill un-notched, short, stout, with few rictal bristles; nostril non-operculate, feathered. Tongue short with truncate, quadrifid tip. Palate similar to that of *Sitta* but with flatter relief. Ten-primaried insect- and seed-eaters of world-wide distribution, plumage similar to that of the Sittidae. *Species dissected: Aegithaliscus annamensis, A. concinnus, Melanochlora sultana, Parus atricapillus, P. bicolor, P. carolinensis, P. gambeli, Sylviparus modestus. Discussion: Sylviparus* is typical despite its thin bill. *Function:* Adduction is greatly strengthened, and the broad ectethmoid suggests less forward vision than in *Sitta*.

PENDULINE TITS (REMIZINAE).—*Diagnosis:* Muscle pattern (figure 17) similar to that of the Paridae but protractors expanded (*M1* pinnate); *M4b* split to accommodate a large palatine salivary gland as in nectar-feeders. Ectethmoid foramen

single, bill conical, without rictal bristles. Palate with boss at point of fusion of central and posterior ridges; tongue elongate but quadrifid at tip. Ten-primaried insect-, fruit-, and (I predict) nectar-feeders of world-wide distribution. *Species dissected: Anthoscopus sp., Auriparus flaviceps. Discussion:* Birds of this subfamily of Paridae are adapted for prying (Lorenz, 1949), and the pendant nest (convergent with Aegithalinae) culminates in the gauze-like bag of the African genus *Anthoscopus*.

Evolutionary Implications of Oscinine Relationships

Comparison with Other Classifications.—Reviews of previous oscinine classifications by Newton (1893–1896) and Stresemann (1927–1934) show that earlier authors could not agree even as to which of the 60-odd families were generalized and which specialized. Few ornithologists appeared to realize that a linear series is no classification at all. Evolution is basically a process of divergence, and those who judged the thrushes, crows, or finches to be the most specialized groups were each right and each wrong. In a branching phyletic tree—the simplest expression of relationships so far as they may be inferred from morphology—all three, equally, are terminal groups. Lacking a phylogenetic tree, there was no classification, only a list of families. Modern ornithologists often show real insight into the relationships of these families, however, and Mayr and Amadon (1951) do a great service in "laying the cards on the table."

The present classification is based on the bird as a whole so far as we know it. Far from cutting across external characters (except bill form), the internal characters employed support and parallel them. Whereas the few available external characters offer multiple choices in deciding relationships, the anatomical characters offer limited choice—both pointing up relationships and ranging groups from simple to complex. The muscle patterns are not absolutely constant in every family—taxonomic characters rarely are. But the adaptive increase in the pinnate character of the jaw muscles in tanagers, for instance, links them to the finches which evolved from them, as supported by external lines of evidence such as color of plumage. These anatomical characters often relate families not previously linked by ornithologists but whose closeness on the basis of plumage is most convincing (cf. Beecher, 1951b). This is because the classifications based on superficial external characters laid great stress on bill resemblance, forgetful of the evolutionary prerequisite that new lines, diverging from an ancestral stock, must be *differently* adapted. Thus they failed as a rule to group families naturally and had no basis for detecting numerous cases of convergence. This gave an erroneous picture of oscinine evolution.

Adaptive Potential.—Evolution is dynamic (cf. Emerson, 1949; 640 ff.). The competing stem groups of Sylvioidea and Timalioidea

seemed under constant pressure to evolve forms adapted for any food-niche insufficiently exploited; and success, aside from accidents of isolation, depended on adaptive potential. For instance, the babblers (Timaliidae) seem to be a microcosm of the Timalioidea as well as the stem group from which its specialized families arose (the transitional Cisticolinae is as much a subfamily of Timaliidae as of Sylviidae). The best check on the evidence that the Timaliidae has given rise to shrike groups is seen in the existence of timaliine shrikes (*Pteruthius*, *Laniellus*). A good check on timaliid origin for other groups is seen in the occurrence of timaliine larks (*Cinclorhamphus*) in Australia where true larks do not occur. Similar examples are seen in what I interpret as timaliine titmice (*Parisoma*, *Myioparus*), creepers (*Climacteris*), and nuthatches (*Neositta*). In the Sylvioidea, one of the best checks on the indicated origin of swallows from flycatchers may be the existence of the swallow-flycatcher (*Artomyias*). Similarly, the origin of dippers from thrushes is made more plausible by the existence of semi-aquatic chats, especially the forktail (*Enicurus*), internally adapted like *Cinclus* for holding slippery prey. These adaptive types are usually few in species and unspecialized when compared to major groups with the same adaptation, characteristically arising where the latter are absent.

Natural Assemblages.—It appears that the subfamilies of the stem Sylviidae may have been differently pre-adapted to seize initial advantages in the competition to fill food-niches made available by flowering plants. Each has apparently given rise to one or more natural assemblages of families with the adaptive potential to occupy all or most niches, and the mélange of species actually filling them in the present cross section of time is the result of a selection process (cf. Park, 1948).

The pinnate *M7b* of the Timalioidea may have conferred an initial advantage in the race to evolve massive, pinnate adductors, for the American finches and the Australian and African weavers all convergently occupy the seed-cracking niche. Their associated nectar-feeding groups may be a necessary link in the series leading to seed-cracking, for only the sylvioid nectar-feeders, the Nectariniidae, Dicaeidae, and Zosteropidae, with a very short, non-pinnate *M7b*, do not have an associated finch group. This reduction of *M7b* may be genetically deep-seated (in terms of pleiotropy) in all pycnonotine assemblages, the reason crows did not evolve a finch despite otherwise highly pinnate adductors. The shrike adaptation also calls for the added power of a pinnate *M7b*, and there are no sylvioid shrikes.

On the other hand, the tendency for *M3b* to expand into a powerful

muscle with a distinct *M. retractor palatini* in the sylvioid thrushes and starlings may have given them the edge in exploiting ground-niches because of increased efficiency in securing slippery prey. A similar development of this muscle has adapted thrashers for digging (Engels, 1940), linnets and weavers for seed-cracking.

Niche Divergence without Plumage Divergence.—Natural assemblages always embrace groups differently adapted as to food-niche. A striking example is seen in the divergence of the starlings (Sturnidae) and swallows (Hirundinidae), which have very similar internal characters, from the flycatchers (Muscicapinae). These groups have evolved parallel plumage types, pointed wing, forward vision, and hole nesting, but are different in their feeding habits. The starling is a ground-feeder, the swallow an aerial feeder; yet forward vision and pointed wing pre-adapt the introduced starling in North America to take over the Purple Martin's niche when the latter flies south. On warm fall days, it feeds in the air, fluttering and gliding like the martin, but with frequent resting.

Again, the larks and pipits are ground-feeders, the monarchs and fantails are flycatchers, yet most of the plumage types of the one have counterparts in the other. There are many exceptions to this, but anatomical characters suggest that both have arisen from the Cisticolinae. The larks and pipits are streaked like the grass warbler *Cisticola* and often have the head and breast recognition pattern of *Prinia flavicans* or *P. pulchra*. The tail-opening trait of the grass warblers may have been transmitted genetically to these descendant groups also. The groups arising from the Cisticolinae may be regarded as a sort of super-assemblage, most of them with some suggestion of the recognition pattern mentioned earlier. Moreover, all are either differently adapted as to food-niche or, if not, appear to have arisen in isolation from each other.

Evolutionary Rates.—Wherever particularly favorable conditions of pre-adaptation, isolation, and niche-opportunity occur, a group may radiate into new major lines. The vireos, the stem group of the nine-primaried assemblage, are a good example of this. This group may have evolved at a higher rate when first isolated in America to produce the more adaptable warblers and tanagers whose success has narrowly limited the vireos' present niche. Despite supposed greater age, however, it remains a primitive "low rate" line with one-third as many species as the warblers and one-sixth as many as the tanagers. When we consider that each of the latter two has likewise given rise to several finch groups with still greater numbers of species, it appears that rate of evolution in this assemblage increases from the stem group to the

terminal group. This is at least partly due to niche opportunities provided by flowering plants.

That rate of evolution is not merely a function of relative abundance of food types but actually signifies heightened adaptive potential in "high rate" terminal groups seems strongly indicated. The American blackbirds (Beecher, 1951a), originating from emberizine finches, were able to occupy virtually all passerine food-niches in a relatively short time, despite the competition of groups already occupying them. The Galapagos finches (Lack, 1947), of emberizine origin, and the Hawaiian Drepanididae, of tanager origin, have done similarly, while the (probably emberizine) finch *Nesospiza* (Lowe, 1923) seems to represent the early stages of such an evolution on Tristan da Cunha. Now there is no evidence that the Galapagos mockingbirds (*Nesomimus*) or Hawaiian thrushes (*Phaeornis*) reached these islands later than the finches, and I believe they were limited to relatively usual niches (Amadon, 1950b) because they represent low-rate lines. Though treated as a terminal group, the thrushes appear to be adaptively restricted by virtual inability to evolve pinnate musculature, and the history of oceanic faunas reveals no instance of such primitive colonizing groups embracing food-niches significantly "outside" their normal ones. The fact is that all of these explosive radiations were accomplished by "high rate" lines, particularly finches.

Validity of the Phylogenetic Tree.—The significance of the above may be that, through competition, the more recent, adaptable groups confine primitive groups to the few niches they fill efficiently. If so, the continued existence of the vireos and the entire sub-oscinine assemblage is the best evidence that for Oscines we can derive family from living family in the present cross section of time. The morphological tree may, therefore, approximate phylogeny—a tree in which dynamic branches are still growing out of a relatively static trunk.

Island Effect.—I do not see a special problem in the larger bill-size of island birds first noted by Murphy (1938: 538). The lesson of the Galapagos finches is that an emberizine stock, small-billed in competition with large-billed tanager finches on the mainland, could escape size restriction and could occupy *all* seed-niches in an island environment where competition is lacking. The larger-billed orioles of Caribbean islands are probably utilizing large fruits and flowers exploited by oropendolas on the mainland. Island forms, representing fewer groups, extend their adaptive range of bill form and size, and even low-rate groups can do the latter. Regarding the tendency toward small size in Rennell Island birds, Hamlin (Mayr and Hamlin, 1931) has commented on the stunted nature of the general vegetation

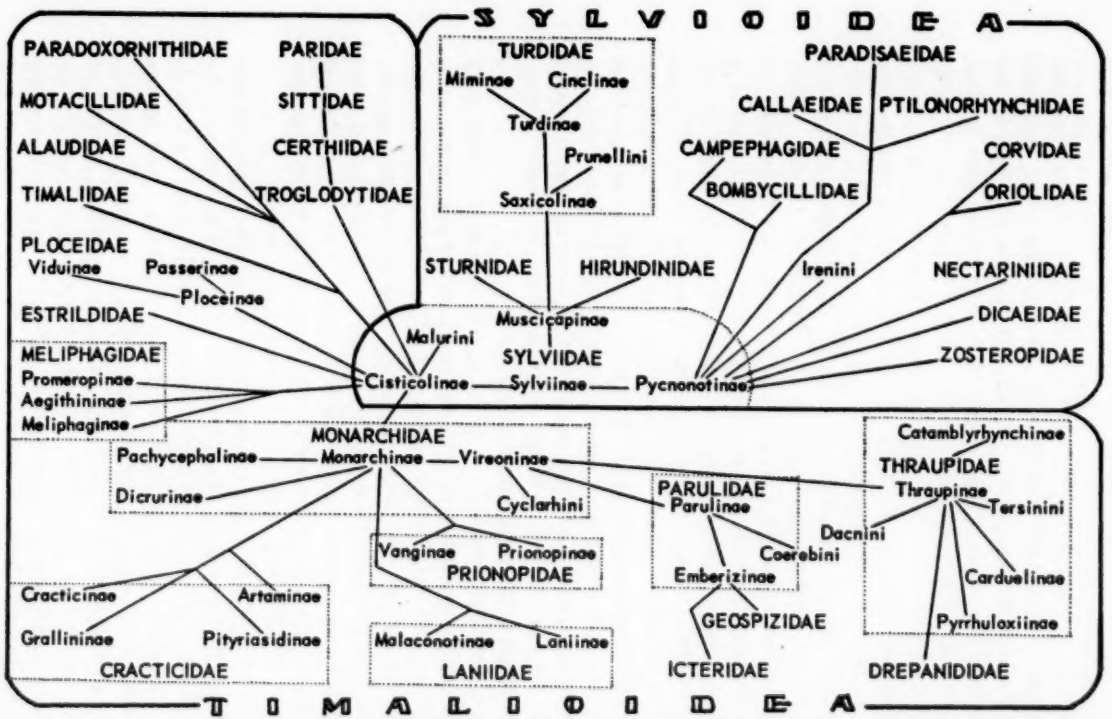


FIGURE 18. PHYLOGENETIC TREE OF THE OSCINES. This is not intended to include tribes. Only such tribes are shown as have been customarily treated as oscinine families—to indicate their reduction in rank. For practical purposes the families here recognized might be arranged in the following linear order with least violence to relationships: *SYLVIOIDEA:* SYLVIIDAE, STURNIDAE, HIRUNDINIDAE, TURDIDAE, ZOSTEROPIDAE, DICAEIDAE, NECTARINIIDAE, BOMBYCILLIDAE, CAMPEPHAGIDAE, ORIOLIDAE, CORVIDAE, CALLAEIDAE, PTILONORHYNCHIDAE, PARADISAEIDAE. *TIMALIOIDEA:* TROGLODYTIDAE, CERTHIIDAE, SITTIDAE, PARIDAE, PARADOXORNITHIDAE, MOTACILLIDAE, ALAUDIDAE, TIMALIIDAE, MELIPHAGIDAE, ESTRILDIDAE, PLOCEIDAE, MONARCHIDAE, CRACTICIDAE, PRIONOPIDAE, LANIIDAE, PARULIDAE, GEOSPIZIDAE, ICTERIDAE, THRAUPIDAE, DREPANIDIDAE.

there. If fruits and flowers are smaller, I would suggest that associated insects may also be smaller, reducing the size range of the whole food-chain.

The Reality of the Higher Groups.—Internal characters fully support the existence of the families as derived by ornithologists mainly through the study of external characters, and this mutual support is the best evidence that these two types of characters are not classifying different parts but the organism as a whole. The recent revisions of the Timaliidae and the Pycnonotidae by Delacour (1946; 1943a) are supported and no very great transfer of species from or into either is proposed on the basis of internal anatomy. The difficulty in distinguishing between the Sylviidae and the Timaliidae, experienced by taxonomists working with external characters, is somewhat borne out by internal characters; the grass and bush warblers (Cisticolinae) prove to be transitional between the two families and could be regarded as a subfamily of either. The value of internal characters is in showing group relationships, so that what were 60-odd equal families fall into a hierarchy of superfamilies, families, subfamilies, and tribes.

Complexity of Terminal Groups.—The terminal groups occupying the outer twigs of the phyletic tree (figure 18) are more complex than the stem group, both anatomically and in degree of behavioral elaboration (nesting, courtship, communal habits, etc.). These are primarily the weaver and finch groups (particularly the icterids), the crows, birds of paradise, bower-birds, and nectar-feeders—all of which, by virtue of special qualification or favorable isolation (or both), have undergone notable radiation. Primitive terminal groups which have also achieved adaptive success with structural and behavioral elaboration are shrikes (Vangidae, Cracticidae), isolated from competing advanced groups.

Evolutionary Relationships.—In a phylogeny expressive of evolution, the various sub-groups of seed-cracking birds are more closely related to primitive insect-eating groups than to each other. Their unusually wide dispersal made possible by their diet of seeds gave taxonomists a false impression of homogeneity not met with in fruit- or nectar-eaters, the Old and New World groups of which do not generally overlap in range. Such convergence between members of the various assemblages appears to be the rule. It may be very close as in finches or as between titmice and parrot-bills or superficial as between the corvine and shrike assemblages. Even where partial, however, convergence is probably always adaptive. The peculiar food-scratching behavior of North American buntings, with unusual development of

the hind claw, occurs in African whydahs. Brood parasitism occurs in African weavers and American blackbirds (Friedmann, 1950) and forms of each, convergent in plumage, tend to occupy similar habitats (*Euplectes–Agelaius*). The long straight hind claw of larks, pipits, snow buntings, and longspurs may be an adaptation for locomotion on mud (or snow), and the coucal (*Centropus*) has similar equipment and inhabits muddy places. One hardly dares to propose that we see in all of these cases of convergence the effects of homologous genes (Spencer, 1949: 23), reflecting the close relationships of these passerine families.

I find myself in rather close agreement with Pycraft (1907) on the resemblances of shrike groups, though I draw different evolutionary implications from them. He marks the similarity of *Tylas* and *Xenopirostris*, both of which I include in Vangidae. He notes the resemblance of *Vireolanius* to what I call the primitive shrikes and of vireos to the Muscicapidae. I would say relationships of the vireos are with the Monarchidae, which I remove from Muscicapidae, and that the Vanginae, Prionopinae, Pityriasidinae, Cracticinae, Artaminae, and Cyclarhini (including *Vireolanius*) evolved separately from the Monarchidae as endemic shrikes in their respective faunal regions. I recognize Wetmore's (1951) contention that *Vireolanius* is a shrike but think it an endemic American shrike arising from the vireos. As in finches, it appears that each of the shrike families is more closely-related to the world-wide monarch-vireo group than to each other. Conversely, the Australian honey-eaters (Meliphagidae) must be expanded to include African and even Oriental groups. Taxonomically, relationships seem more complex than was assumed from external resemblance alone.

Origin and Dispersal.—Mayr (1946) stated the problem posed by related barbets, trogons, and parrots isolated in the tropics of the Old and New Worlds. It applies equally to the ancient suboscinine assemblage apparently displaced into the southern continents by a modern oscinine assemblage arising from it (cf. Matthew, 1915). The oriental Eurylaimidae, represented in Africa by the relict, *Smithornis*, is probably close to the New World Cotingidae (Pycraft, 1905). The Pittidae, Philepittidae, and Xenicidae show a notably disjunct distribution in the Old World tropics and must have been early separated from the closely related Furnariidae, Dendrocolaptidae, Tyrannidae, etc. of the New World tropics. Their sedentary habits virtually require that all of the latter groups must have been in South America before the Eocene Central American water gaps isolated it from North America until the end of the Tertiary. The problem ap-

plies also to primitive members of the oscinine assemblage. The nine-primaried American families arose to fill food-niches provided by the flowering plants in isolation from Old World groups, so the stem vireos may have reached America before the origin of flowering plants. The vireos arose from the Monarchidae, and these shrike-flycatchers, with the endemic primitive shrike groups arising from them (above), show a mainly tropical distribution pattern. This world-wide, pantropical pattern is often met in late Cretaceous groups (Beaufort, 1951). Sarasin (1910) notes 11 genera of reptiles and amphibians, 8 of land mollusks, and 6 of terrestrial flatworms with similar distribution. It is quite characteristic of skinks, iguanas, geckos, and boas, as well as of primitive insectivores and lemurs among mammals, though Simpson (1945) states that the relationships in these groups are still problematical.

The dilemma of zoogeographers seeking a former tropical exchange corridor at the north to account for these related, pantropical groups is that Bering bridge has not been even subtropical as far back as the Cretaceous (Stegmann, 1938; Chaney, 1940). Although Simpson (1947) finds it adequate to explain Tertiary mammal distributions, the above dispersals are believed to have occurred earlier—and even Simpson admits the bridge favored cold-adapted forms. On the other hand, there is a tropical angiosperm-gymnosperm flora in the Upper Cretaceous of Greenland, elsewhere met only in the American Potomac flora (Seward and Conway, 1935). This, with the subtropical floras of Western Europe and the London Clay in the Lower Eocene (Reid and Chandler, 1933), suggests a milder climate in the North Atlantic area. The latter flora, of Malaysian affinities, is thought to have occurred on the north shore of the Tethys Sea as a result of warm currents from the Indian Ocean (Brooks, 1926). The Potomac flora implies Cretaceous contact of North America with Greenland and possibly with the British Isles via Iceland, though not necessarily all at one time.

Geological evidence has not eliminated the possibility of Mesozoic drift of continents, and our understanding of faunal and floral relationships must be refined before this issue can be decided biogeographically. Since the velocity of the earth's rotation is 1000 miles per hour at the equator and 0 miles per hour at the poles, North America and northwestern Europe might have been in contact long after Africa and South America had drifted apart. If such a connection existed as recently as Upper Cretaceous, it would have been a tropical one, and the tropical flora would have retreated toward the equator in the several continents during the climatic deterioration following the

regression of Tethys Sea into the present Mediterranean. In so doing it would have fragmented along with its faunas; and in Old and New World tropical regions, thus separated, parallel evolution of static, early-specialized groups (barbets, trogons, parrots) might be expected. But the generalized passerine insectivorous stocks might have tended to diverge rapidly in response to the available food-niches provided by the flowering plants, evolving different assemblages in the Old and New Worlds. However, most authors, like Darlington (1948), prefer the Bering bridge to its alternatives.

Other primitive insectivorous groups might have been expected to enter America along with the suboscines and vireos. *Polioptila*, *Microbates*, and *Ramphocaenus* may be relicts of a branch of the world-wide Sylviidae that did not survive well in competition with the American warblers. *Ramphocaenus* I regard as an American endemic only convergent with the African *Macrosphenus* and the oriental *Orthotomus* which it resembles. To have given rise to the Mimidae, thrushes would have had to arrive early, and so would swallows. Since wrens apparently are not related to thrashers, they may have evolved in the Old World, where competition with grass and bush warblers (Cisticolinae) early forced them into the grassland and desert niches of the New World. The initial presence of wrens and thrushes may have prevented extensive exploitation of the ground-niche by the insect-eaters of the nine-primaried assemblage. Considerable divergence of the Bombycillidae from the nearest Old World groups (bulbuls and cuckoo-shrikes) suggests early arrival. But most Tertiary interchange after this initial period would have been by cold-adapted species across the Bering bridge. Mayr's analysis of the North American bird fauna (1947) is admirable and makes further discussion here unnecessary, except that, since the "Old World" finches arose from tanagers in the New World, their Eurasian radiation is secondary. Its extent, however, suggests that the seed-cracking niche was vacant in Eurasia and that the Ploceidae reached the Palaearctic rather late.

Faunal relationships and geology both indicate that the Ethiopian and Oriental regions were in contact in the Upper Cretaceous when the Deccan volcanism devastated 250,000 square miles of peninsular India, isolating its southern tip and Ceylon. North of the Deccan, the Tethys Sea extended from Europe to Africa, divided into northern and southern components by a land mass extending from Africa to northern India (Lake, 1939). The distinctive African relicts of primitive groups like the Eurylaimidae, Pittidae, and Timaliidae (*Picathartes*) and oriental relicts of the African Prionopinae (*Tephrodornis*) suggest the early closure of this faunal bridge. Since the Timaliidae

are scarce and the Pittidae absent on Ceylon today, these groups may have survived in a semi-isolated northern India, caught between the rising Himalayas to the north and the Deccan to the south with a receding Tethys on the west. Otherwise it is hard to account for the species- and niche-radiation there. The smaller number of species in the Australian Region may indicate isolation at the same time, but their importance in occupying its niches cannot be over-emphasized. The Pycnonotidae may also be an old Oriental group.

Faunal exchange was again possible in Miocene-Pliocene times when forest covered most of Africa with a belt across Arabia to the Oriental Region (Lonnberg, 1936; Beaufort, 1951). This accounts for the similarity of the Ethiopian and Malaysian forest bulbuls, babblers, and cuckoo-shrikes noted by Chapin (1932), who also thinks most African savanna birds arrived via a savanna belt north of this forest. I agree with him that the Malaconotinae and Laniinae could have arisen in Africa and that the Ploceidae, Viduinae, and *Cisticola* may have arisen in savanna south of the forest barrier, but I consider the last three closely related. The Estrildidae, arising in Australia, first entered the savanna north of the forest, in my opinion, and their parasitization by the Viduinae may, thus, date from the joining of the northern and southern savannas with regression of the forest in late Tertiary times. The Viduinae are the only weaver group confined to Africa.

CONCLUSIONS

The direct correspondence of all very early, world-wide distribution patterns with just those insectivorous passerine groups judged primitive on anatomical characters, the major assumptions of this work are confirmed. The fruit-, nectar-, and seed-eating groups, judged later in origin and more advanced, are of limited distribution, and this agrees with the separation of the faunal regions as the Tertiary unfolded. By their existence, these world-wide, primitive groups—confined mainly to insectivorous niches by the more advanced groups that apparently arose from them—make it less necessary to postulate extinct common ancestors for which we have no evidence and which probably were similar to modern sylviids. The morphological tree for the rapidly evolving Oscines may be a fair approach to a phylogenetic tree.

The working method, therefore, seems to be valid, and this arrangement of oscinine higher groups may be permissible as a first approximation. Allowance must be made for subjective judgements as to relationships between closely related groups in a still-evolving complex; but this is implicit in any classification, and we may hope for

refinement as our understanding grows. This first attempt at a phylogenetic arrangement of the Oscines is offered for appraisal in terms of present and future ornithological facts.

SUMMARY

An attempt is made to clarify the relationships of the higher groups (families) of oscinine birds and to erect a phylogeny based on the methods of comparative anatomy. Several independent lines of anatomical evidence in the head region, particularly the jaw musculature, are used, but external characters are also considered. The working method assumes that structurally simpler characters are primitive and an initial separation of the suborder into the superfamilies Sylvioidea and Timalioidea is based on a simple but constant muscle difference. Within each of these, the families are arrayed in a hierarchy of increasing general complexity as they become adapted to the fruit-, nectar-, and seed-niches provided by the evolution of flowering plants. Most complex are the groups forming the terminal twigs of the phylogenetic tree, and here, especially, much convergence is noted. For example, the various finch sub-groups are found to be more closely related to insectivorous stocks in the same assemblage than to each other. The result is a classification more complex than one based on external characters which would place all finches together. Groups judged to be primitive anatomically all prove to have a world-wide distribution pattern believed to date from Upper Cretaceous time. The original assumption that more advanced groups were restricted in distribution by the separation of faunal regions in more recent periods is confirmed by anatomical relationships. The method seems, therefore, to be valid, and the morphological tree is believed to approximate phylogenetic relationships.

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THE SYSTEMATIC POSITION OF THE GENERA *RAMPHOCAENUS* AND *MICROBATES*

BY A. L. RAND AND MELVIN A. TRAYLOR, JR.

THE systematic position of the neotropical genera *Ramphocaenus* and *Microbates* has been the subject of considerable speculation. Originally considered to be troglodytine, they were placed on the basis of external characters in the mesomyodian family Formicariidae by Burmeister (1856, 3: 72) and Sclater (1858: 243), following Müller's (1845) division of the passerine families on the basis of the musculature of the syrinx. They were retained in the Formicariidae by all reviewers through Cory and Hellmayr (1924: 205).

In 1921, however, W. DeW. Miller, in a presentation before the American Ornithologists' Union, showed that on external structural characters, particularly the presence of an aftershaft, *Ramphocaenus* and *Microbates* could not be retained in the Formicariidae, and he proposed to erect a separate oscine family for them, placed near the Sylviidae. Wetmore (1943: 306) found on dissection that *Ramphocaenus* has an oscine syrinx and placed it in the Sylviidae. Finally, Peters (1951: 213) has removed *Ramphocaenus*, *Microbates*, and the related *Psilorhamphus* from the Formicariidae for subsequent inclusion in the Sylviidae.

Within the Sylviidae, *Ramphocaenus* and *Microbates* have recently been placed in the tribe Polioptilini by Mayr (1946: 18, 27) and Mayr and Amadon (1951: 18), the only neotropical group they recognize of the Old World sylviids.

Polioptila is a closely knit genus of about ten species, equally well represented in Central and South America, but apparently with a tropical North American center of evolution (Mayr, 1946; 18).

Ramphocaenus (2 species) and *Microbates* (2 species), as genera, are very similar to each other, except for slight differences in proportions of tail, bill, and tarsus. *Psilorhamphus* (1 species), which we have not seen, appears similar but with a different, heavily spotted plumage. Although *Ramphocaenus* and *Microbates* have been linked with *Polioptila*, they appear to be much more closely related to certain other Old World warblers, especially the African genus *Macrosphenus*. This genus, too, has had various places in classification. Originally considered troglodytine by its describer, Cassin, it has since, as stated by Sclater (1930: 365), been "placed in the Sylviidae by Reichenow, the Timaliidae by Sharpe [and] the genus seems to have affinities to the Laniidae." The more recent reviewers, Mackworth-Praed and

Grant (1944: 444) and Delacour (1946: 12), have placed it again in the Sylviidae, the latter in the tribe Orthotomini. *Macrosphenus* contains three species, all African (some would also include the genus *Suaheliornis* in it). There is some variation within the genus *Macrosphenus*, and it is the species *M. kempi* that is especially close to *Ramphocaenus* and *Microbates*, not only in form but in color and pattern.

In gross appearance of skins, the species of *Polioptila* are all much alike, slaty and whitish with short fine bills, fairly long tails with white outer tail feathers, moderate feet that fall well short of the tip of the tail. By contrast *Ramphocaenus*, *Microbates*, and *Macrosphenus kempi* are brown, gray, and buffy; the bill is much longer and heavier; the feet are larger, reaching in most species to the tip of the tail; and there are elongate, silky flank and rump feathers. A tabular summary of the points in which they differ follows:

	Polioptila	*Ramphocaenus*, *Microbates*, and *Macrosphenus kempi*
BILL	Fine; shorter than head; very slightly hooked	Longer than head; wider, especially basally; more distinctly hooked
RICTAL BRISTLES	Moderate	Present but less well developed
WING	Moderately rounded; remiges narrow, moderately curved, and 10th (outermost) about half length of 9th	More rounded; remiges broader and more curved; 10th primary considerably longer than half of 9th
TARSUS	Slender, scutellate	Scutellations more obscure
TOES	Rather slender; basal phalanx of middle toe joined with outer toe and partly to inner toe; claws moderate	Slightly heavier; basal phalanx of middle toe completely, and second phalanx partly, united with outer toe; basal phalanx of middle toe partly united with inner toe; claws slightly heavier
TAIL	About as long as wing	Shorter than wing (in *Psilorhamphus* said to be as long as wing)
PLUMAGE	Rump and flank feathers dense, somewhat decomposed at tips, but little lengthened	Rump and flank feathers distinctly decomposed, silky, and lengthened.
COLOR	Predominantly slaty and whitish	Browns and grays
HABITAT	Trees and bushes	Shrubbery in forest
NEST	Compact cup fastened to branches of trees	Deep cup loosely attached to broad leaves of a plant, 18 inches from ground (one record *Ramphocaenus*)

The conclusion from these data seems inescapable, that *Ramphocaenus* and *Microbates* (and probably *Psilorhamphus*) are much more like *Macrosphenus* than they are like *Polioptila*. Mr. William Beecher, who has examined the jaw musculature of specimens of *Polioptila*, *Ramphocaenus*, and *Macrosphenus*, says that he has found nothing

contrary to this view. Indeed, if it were not for their distribution one would be inclined to consider uniting, generically, *Ramphocaenus* and *Microbates* of the Neotropics and *Macrosphenus* of Africa.

One should consider the possibility of convergent evolution, the African and the American birds having evolved from different parts of a common basic stock. However, the lack of related forms in the New World makes this unlikely.

TABLE 1

MEASUREMENTS OF CERTAIN FORMS DISCUSSED (IN MILLIMETERS)

	Wing	*Tail*	*Exposed culmen*	*Tarsus*	*Specimens*
Macrosphenus kempi	60	40	18	21	one male
Macrosphenus flavicans	62	41	16	20	av. 4 males
Macrosphenus concolor	56.8	42.6	14.5	21.5	av. 5 males
Ramphocaenus melanurus	48	43	—	—	Sclater.[1]
Ramphocaenus rufiventris rufiventris	51.2	40.9	24	20.9	av. 18 males, Ridgway.[2]
Microbates cinereiventris semitorquatus	53.9	27.7	18.1	23.7	av. 13 males, Ridgway.[2]
Microbates collaris	51	25.5	—	—	Sclater.[1]
Polioptila caerulea caerulea	52.1	50.3	9.9	17.2	av. 24 males, Ridgway.[3]

[1] Sclater, 1890: 260, 263. [2] Ridgway, 1911: 85, 89. [3] Ridgway, 1904: 716.

The alternative is that there have been two intrusions of the Old World warblers into tropical America; one resulted in the present *Polioptila*, and the other in the *Ramphocaenus* group.

Disregarding cosmopolitan groups, the avifaunae of Africa and South America are most distinct, having few close relatives in common. Most of the latter belong to families that are pan-tropical in distribution, including the Trogons and Barbets among land birds and the Heliornithidae, Jacanidae, Anhingidae, and Rostratulidae among aquatic birds. All of these groups are old and presumably have possessed temperate representatives in the intervening areas at some time in the past. Such representatives would have bridged the present large gaps in their ranges. There are also two species, *Plegadis falcinellus* and *Dendrocygna bicolor*, which are circumtropical without showing even racial variation, and they are almost certainly examples of transoceanic dispersal.

There are, however, among land birds a very few cases where the same or closely related genera are found both in South America and Africa. One of these is *Ciccaba*, a neotropical genus of wood owls, which has a single widespread species in Africa; a second is the monotypic owl genus *Jubula* of Africa, which, according to Peters (1938: 184) is scarcely separable from the neotropical *Lophostrix*. Among

passerine birds, the relationship between *Ramphocaenus* and its allies and *Macrosphenus* appears to be unique.

Final action on the classification and nomenclature of the various genera of the Sylviidae should await a revision of the family. Until this is done we suggest that it be recognized that certain small neotropical genera are more similar to certain African birds than to the New World gnatcatchers, and that some of the genera now recognized are very finely split. The zoogeographical implications seem evident, however; the few neotropical representatives of this large, predominantly Old World family do not form a natural group, and apparently represent two invasions.

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AUTUMNAL MIGRANTS ON THE CAMPECHE BANK

BY RAYMOND A. PAYNTER, JR.

INTRODUCTION

EXTENDING for approximately 400 miles along the western and northern coasts of the Yucatán Peninsula is a vast area of shoals and islets known as the Campeche Bank. Within the bank there are but four groups of small islands which are sufficiently above the sea to support a permanent terrestrial flora and fauna. These groups are known as Cayos Arcas (20° 13′ N., 91° 58′ W.), Arrecifes Triángulos (20° 58′ N., 92° 20′ W.), Cayo Arenas (22° 07′ N., 91° 24′ W.), and Arrecife Alacrán (22° 23′ N., 89° 40′ W.). All lie between 80 and 100 miles from the mainland and, because of their extreme isolation and the dangerous nature of the surrounding water, are visited only by an occasional fisherman and the ship which supplies the lighthouse keepers seven or eight times each year.

The only publications relating to the avifauna of this area appear to be those of Dampier (1700), Marion (1884), Ward (1887), and Kennedy (1917). The first three merely mention the resident avifauna of the Triángulos and Alacrán in passing; the last is concerned with a brief visit to Arrecife Alacrán in May, 1912, during the nesting season of the numerous seabirds. Goldman (1951) collected on both Cayos Arcas and Arrecifes Triángulos in June, 1900, but his ornithological observations have never been published, although his specimens have been used in taxonomic and faunal works.

After several years of negotiation in an attempt to arrange for transportation to these islands, I had the good fortune to secure the assistance of American Vice-Consul Abraham Katz, of Mérida, Yucatán. Mr. Katz obtained the generous coöperation of Captain Aaron Rodriquez V., captain of the port of Progreso, Yucatán, who permitted me to accompany the government-chartered ship, the "Oscar Coldwell," on one of its regular visits to supply the lighthouses.

Although my primary objective in visiting the islands was to observe the resident avifauna, which consists solely of seabirds, it was discovered that migrants were present in abundance. This provided an unusual opportunity to obtain information bearing on the problem of migration across the Gulf of Mexico, which in the past few years has become a controversial topic with Lowery (1945, 1946, 1951) taking the stand that spring trans-Gulf migration is of regular and normal occurrence, while Williams (1945, 1947) holds that it occurs irregularly and accidentally. Autumnal trans-Gulf migration has not been con-

sidered so thoroughly, but its existence is less disputed with even Williams admitting (1947: 218), ". . . I have long known that some birds (especially young ones) cross the Gulf in autumn."

In this paper, I wish to treat of my observations of autumnal migrants, reserving an account of the resident birds for a general study of the avifauna of the Yucatán Peninsula, now in preparation.

OBSERVATIONS

On the afternoon of August 27, 1952, in company with Mr. John C. Pallister, of the Department of Insects and Spiders of the American Museum of Natural History, and Andrés Beeza, my local collector, we sailed from the port of Chicxulub, Yucatán. At 6:30 that evening, while about 3 miles from the coast and slightly west of Sisal, Yucatán, the first of the migrants was sighted. It was a medium-sized bird, flying a few feet above the water, which came from due north and was headed for the mainland.

The ship followed the coast of Campeche during part of the night and then turned abruptly to the west toward Cayos Arcas, arriving within sight of the islands at noon. Unfortunately, with only the aid of a compass, navigation was conducted by dead reckoning, and it is not possible to state with accuracy the position of the boat at any given time while at sea.

Beginning at 7:00 a.m. on August 28, with no land visible, the sea was carefully scrutinized for birds. Other than for a period between 11:30 and 11:50, when I was having lunch, observations continued until we entered the harbor at Cayos Arcas at 1:30 p. m. During the six hours of observation, 75 migrants were seen. None was seen before 8:10, 54 birds had passed by 9:45, and 70 by noon. The wind was from the south, rather brisk, and all the birds came from due north and headed directly south, flying between 2 and 20 feet above the water, with the majority not higher than 10 feet. Six birds were observed singly, while 37 came in groups of two to six birds and the remaining in flocks containing 9, 10, and 13 birds respectively.

Because the birds were flying close to the water, it was difficult to see them before they were quite near to the ship. This, coupled with the fact that the ship lurched violently, made careful observation with binoculars impossible; but one Prothonotary Warbler, seven Hooded Warblers, and two Barn Swallows were identified without question. Water-thrushes, Summer Tanagers, and Baltimore Orioles were questionably identified, and the fact that they were later seen on the islands lends support to the identification. The remaining birds were small, probably warblers, or possibly Bank Swallows.

The two Barn Swallows followed the ship, often alighting on the ropes, from 11:00 until we were within 2 miles of the islands, when they flew off in that direction. Four small birds passed in a flock at 1:07, when the islands were in clear view, but they made no attempt to deviate from their path and flew past them.

We landed on Cayos Arcas at 2:30 in the afternoon and worked there until the following evening, spending the entire time on the largest of the three cays, which is roughly 1200 yards in length and 400 yards in width. The island is, for the most part, covered with low fleshy plants, the only vegetation of any stature being a few coconut palms (*Cocos nucifera*), Australian pines (*Casuarina* sp.), and sea grapes (*Coccolobis* sp.), which grow near the lighthouse and its outbuildings. Migrants swarmed around these few trees and bushes and were found in lesser numbers in the clumps of sea lavender (*Limonium* sp.) which are scattered over the island.

A list of the 25 migratory species observed is given in table 1. Because of the dense concentration of birds, it was impossible to count the more numerous species with any degree of accuracy. Those figures in table 1 which are followed by the sign "±" represent very conservative estimates of the numbers present and are more useful as indications of the order of magnitude. On Arrecifes Triángulos and Cayo Arenas, two very small islands, the populations were smaller and more dispersed, and the counts probably represent a fairly accurate census.

Some indication of the density of the population may be obtained from the following calculations. The clump of sea grapes occupied an area of about 300 square yards and, with the exception of the swallows and martins, at least 90 per cent of the passerine birds were in those shrubs. Therefore, as a conservative estimate, roughly 350 birds were in the area, or slightly more than one per square yard. The actual concentration was even greater because there is no natural source of fresh water on the island and the birds clustered around a pan of water placed under the bushes for the chickens kept by the inhabitants. It was not unusual to see 10 warblers drinking simultaneously from the pan, with dozens waiting in the branches above.

The lighthouse keepers claimed that each year migrants arrive in great numbers but all die within a short time of their arrival because of the lack of water and food. A few birds were found dead, and many were in poor condition with their wings spread and bills open, obviously suffering from the intense heat made worse by patches of glaring white sand. However, I believe that many of the birds live to reach the mainland since houseflies (*Musca* sp.) abounded in the

vicinity of the buildings and were present in clouds inside the buildings. Without fear of exaggeration, it may be said that the floors of the houses were black with flies. Neither Mr. Pallister nor I had ever seen the equal. Hooded and Yellow-throated warblers readily entered the buildings to feed, and as we sat outside on the stairs many species pursued flies fearlessly in the sand at our feet.

The heavy mortality noticed by the keepers probably occurs among the swallows and martins, which flew incessantly over the island, although no flying insects were noted a short distance from the buildings. All swallows and martins collected had empty stomachs and none had even a trace of fat. Without doubt, few of these birds leave Cayos Arcas, but those birds feeding on the flies may well reach the mainland after spending a short time on the island. The lack of birds noticed by the inhabitants later in the season is probably due to a combination of mortality and of a renewed migration to the mainland.

Among the migrants observed and collected there are several of more than usual interest. The Bank Swallow has never been recorded from the mainland of the Yucatán Peninsula and only once from Cozumel Island, Quintana Roo (Salvin, 1888: 257). The Western Sandpiper is another species which has been recorded only on Cozumel (Salvin, 1889: 379). The Golden-winged Warbler has been observed on a few occasions in other parts of Mexico but never on the Yucatán Peninsula.

We left Cayos Arcas in the early evening of August 29 and arrived within sight of the lighthouse on Arrecifes Triángulos about 6:30 the following morning. Unfortunately, this schedule afforded little opportunity to observe migrants over the open sea while en route, but at 6:40 a Barn Swallow came aboard and shortly after, a Green Heron circled the ship several times, then flew to the island. Neither bird was seen to arrive, and therefore the direction from which they came is unknown.

The Arrecifes Triángulos contain three isolated small reefs, one to the east, one to the west, and one to the south. The lighthouse is situated on the western reef, Triángulo Oeste. The cay is about 700 yards long and 200 yards wide and composed of masses of broken coral and a little sand. The only vegetation is sea lavender which grows in a small strip.

A landing was made on Triángulo Oeste at 8:15. The broken coral was hot and bright, and most of the birds were found near the house where there was a little shade and a few flies. There were several dead migrants beneath the light, and the living birds appeared weakened and hungry. Insects were almost entirely wanting except

for a few grasshoppers. As Mr. Pallister disturbed the grasshoppers during his collecting, a Barn Swallow followed him and quickly devoured any it could catch.

We sailed for Cayo Arenas at 1:00 p. m. but saw no migrants until 6:30 p.m., when a Barn Swallow was noticed circling the ship a few times. It was not seen to leave and the direction in which it headed is not known.

The light on Cayo Arenas was sighted during the night, but we were forced to lie off-shore until dawn because of the dangerous reefs. At 5:50 a. m. a small bird was seen and three more during the next 15 minutes. All were flying south into a strong southeasterly wind.

At 7:00 a. m. on the 31st we landed on the cay which is roughly circular with a radius of approximately 300 yards. One-third of the island is composed of sand, while the remainder is of coarse broken coral. There are two large patches of cactus (*Opuntia* sp.) and scattered clumps of sea lavender which together cover only one-fifth of the island.

As on Triángulo Oeste, the few migrants present were concentrated near the buildings. During the morning three Green Herons in a flock and a single Eastern Kingbird were seen to approach from the north and land on the island.

In the early afternoon we left the harbor of Cayo Arenas. A Barn Swallow which followed the boat for a few minutes late in the afternoon was the only migrant observed until the following morning, when between 6:00 and 8:00 a. m., 10 small birds were seen. It was possible to identify one Water-thrush and three martins. All of the birds were headed due south with a strong southeasterly wind impeding their flight. The trees on Isla Pérez, of the Alacrán group, could be seen by 9:00 when a Parula Warbler came aboard to rest for a few minutes.

Arrecife Alacrán is a large elliptical reef about 17 miles long and half as wide at its greatest breadth. There are five small islands located on its western and southern sides. Isla Pérez, the largest, is one-half mile long and 200 yards wide, situated at the southern end of the reef. It is covered fairly thickly with low bushes; a line of Australian pines runs the length of the island. The lighthouse with its associated buildings is in the center of the island. A few miles to the southeast of Isla Pérez are two very small grass-covered cays known as Isla Pájaros and Isla Chica. Three miles to the northwest of Isla Pérez is Isla Desertora, another small cay. Approximately 3 miles from the northern end of the reef is Isla Desterrada, second in size to Isla Pérez in the group. It is roughly 400 yards in length, half as wide, and with a scant covering of sea lavender.

We remained at Arrecife Alacrán from mid-morning of September 1 until mid-morning of the third, spending most of the time on Isla Pérez. Short trips were made to Islas Pájaros and Desterrada where the only migrants were a few Barn Swallows and Ruddy Turnstones, plus a single Wood Pewee on the former island. Isla Chica and Isla Desertora were approached closely in a boat and found to be devoid of migrants.

Although there is more vegetation on Isla Pérez than on any of the other islands on the Campeche Bank, the migrants were not so abundant as on Cayos Arcas. Insects were only slightly more common than on Triángulo Oeste and Cayo Arenas, and fresh water again was not present. Several species not found on the other islands were recorded, and the Cerulean Warbler was collected, apparently representing the first record of this species from the Yucatán area since it was collected by Schott at Mérida over 80 years ago (Lawrence, 1869: 200).

We arrived at Chicxulub early in the evening of the third, but during the entire 80-mile trip from Isla Pérez the only migrant seen was a single Barn Swallow about one hour after we had left the island.

DISCUSSION

The number of migrants observed at sea and the times when they were seen offer material for interesting speculation. It is unfortunate that travel between the islands could not have been during the same hours each day, thereby providing a greater degree of uniformity in the periods of observations, but controlled observations were, of course, impossible. Nevertheless, it will be noted that more migrants were observed in the mornings than in the afternoons and the one full morning of observations showed a peak movement between 8:00 and 10:00 a. m. This would seem to indicate that most of the birds left land at more or less the same hour, but to determine the hour with any degree of accuracy is impossible with the data at hand.

Although it may be imprudent, it is still of interest to speculate a bit. Considering the migrants observed on August 28 while we were en route to Cayos Arcas, it will be seen that if their direction of flight remained constant from the time of their departure from land until they were sighted from the ship, the nearest land from which they could have come is the coast of Louisiana, a distance of roughly 650 miles. Small birds are usually considered nocturnal migrants. If, however, the birds began their flight at dusk on the Louisiana coast, only approximately 12 hours were available for them to make the flight of 650 miles. This would require a flight-speed of over 50 miles

per hour which seems an excessive requirement, especially in view of the fact that for at least part of the time they were flying into a brisk wind.

It may be argued that the flight did not begin on the coast of Louisiana but elsewhere along the Gulf Coast. However, the only manner by which the distance from land to the observation point could be shortened sufficiently to permit a significantly lower flight-speed would be to assume that the birds departed from the coast of Mexico somewhere in the State of Veracruz. This would involve the spurious assumption that the birds flew due east from Veracruz and then turned at a right angle in order to approach the ship from due north.

An alternative assumption, which better fits the few data available, is that the birds observed began their migration across the water during the day and may have been in flight as long as 24 hours. Individual variations in flight-speed and the time of departure would account for the scattered observations during the entire day. Undoubtedly migrants passed during the night but were not observed.

The observations made during the morning of August 28 provide material for estimating the number of migrants which may have been passing over a considerable area of the Gulf at the same time. It will be noted that the ship was traveling on an east-to-west course, or, in other words, directly across the path of migration.

During the entire period of observation I was seated amidship on the starboard (north) side which permitted a clear view in an arc from east to west. The area was scanned for migrants, and when one was sighted binoculars were used in an attempt to identify it. It is doubtful whether these small migrants could have been seen with the unaided eye for more than an eighth of a mile, which would mean that a total of one-quarter of a mile across the path of migration could be kept under observation. An eighth of a mile may appear to be a very short distance for observing birds in an unobstructed field, but it should be recalled that the birds were flying close to the water. From the deck of even a small ship, low flying objects are seen below the horizon, *i. e.*, against the water, while still a considerable distance from the observer and are difficult to see. This, of course, is the principle employed by airplanes in attacking warships.

The peak of the flight occurred from 8:10 to 9:45, a period of 95 minutes, during which time 54 migrants passed. It was difficult to ascertain the speed of the ship during this time, but the captain, a man of considerable experience with his ship, estimated that we were traveling at approximately 7 statute miles per hour. This would

mean that in 95 minutes we covered 11 miles across the migration path. There is no reason to believe that within these 11 miles at sea we were passing through any strict flight-line or that we would not have seen 54 birds if we had been standing still. Therefore, for the sake of simplicity, it is possible to consider the 54 migrants as having passed an east-to-west line one-quarter of a mile in length. Expressed differently, migrants crossed at the rate of one every 1¾ minutes, or 34.21 birds per hour. Projecting this in terms of the numbers crossing a line one mile long, it would be nearly 137 birds per hour.

It is unknown over how wide an area these migrants were passing on the morning of the 28th, but since on succeeding days migrants were observed the entire distance from Cayos Arcas to Arrecife Alacrán, a distance of somewhat more than 200 miles, it appears warranted to assume that they were probably crossing at least a 200-mile stretch of the Gulf. Flight-lines are assumed to be lacking over open water, and therefore it is more than likely that migrants were rather evenly distributed along the entire line. Even if these assumptions are only approximate, it would mean that at the height of the flight on August 28 more than 27,000 migrants per hour passed between Cayos Arcas and Arrecife Alacrán. Going one step further, if migrants cross in direct lines, landing on the entire Gulf coast of the Yucatán Peninsula, which is about 500 miles in length, an estimated 68,000 birds reached the shore during each hour of the peak period.

If the fall migration pattern which was observed during the entire trip is the normal one, probably about one-half of the migrants pass during a two-hour period with the remainder scattered throughout the day. (Nocturnal migrations over the open Gulf must be neglected because of the lack of observations.) This would mean that over 137,000 birds arrive on the Peninsula in each daylight period. It is unknown how long the migration period is, but it must last at least a month. If flights of the same order of magnitude as those observed occur during only 10 days of the period, there would be a minimum autumnal migration of 1,370,000 birds.

Although highly speculative, these estimates do not appear unreasonable and are undoubtedly very conservative. Nevertheless, they do provide a basis for future studies and are presented with the hope of stimulating discussion and research in an already highly provocative phase of ornithology.

To this point, the stand has been taken that autumnal trans-Gulf migration is a regular and normal event, but what is the evidence leading to this belief?

The one irrefutable fact that is evident from these recent observations is that the migrants over the open sea and on the islands either were performing, or had performed, a trans-Gulf migration. Whether or not this was a normal phenomenon may be debatable, although all the evidence seems to indicate the affirmative.

The occurrence of non-pelagic birds over the open Gulf of Mexico in the autumn has long been known (see Lowery, 1946, for a full list of records to that date; also Paynter, 1951, for several later records). The lighthouse keepers on all the islands visited by me had witnessed these migrations annually and did not consider the 1952 season in any manner extraordinary. However, the mere fact that there are many observations of this phenomenon does not in itself testify to its normality, but coupled with other data a strong argument is created favoring the hypothesis that migration across the Gulf is a normal route for many species in the autumn. Spring trans-Gulf migration is another matter and will not be considered here.

During the period of observations on the Campeche Bank there were no marked meteorological changes along the Gulf Coast of the United States which may be said to have "forced" coastal migrants out to sea—an argument frequently used to contest the normality of spring trans-Gulf migration. There was a rainy area in the middle of the Gulf on August 26, but as it did not originate on the coast it could hardly have influenced the migrants before they left the mainland. An occluded front moved down to the coast in early September, and a hurricane swept along the east coast of Florida in late August, but these disturbances were either too late or too distant to have influenced the birds observed in migration.

Further arguments in favor of the normality of the migration may be found in the fact that very few of the birds circled or settled on the ship, which may be interpreted as an indication they were not exhausted waifs searching aimlessly for a resting place. Also, the consistency of the direction of the flight along the entire 200 miles of the Campeche Bank which was visited appears indicative of a normal migration. If the birds had been forced out to sea, a disturbance at least 200 miles in breadth would have been necessary to produce such a pattern.

Therefore, there seems little reason to doubt that the autumnal trans-Gulf migration observed on the Campeche Bank is a normal and yearly event. While data are not abundant enough for us to more than speculate on the magnitude of this migration, they do indicate that it is far more than a casual affair and fully warrants additional research.

TABLE 1

AUTUMNAL MIGRANTS ON THE ISLANDS OF THE CAMPECHE BANK

Species	*Arcas*	*Triángulo*	*Arenas*	*Alacrán*
American Egret (*Casmerodius albus*)	1			
Snowy Egret (*Leucophoyx thula*)		1		
Green Heron (*Butorides virescens*)		2	4	10±
Yellow-crowned Night Heron (*Nyctanassa violacea*)				1
Black-bellied Plover (*Squatarola squatarola*)				5
Ruddy Turnstone (*Arenaria interpres*)			10	50±
Spotted Sandpiper (*Actitis macularia*)	2	2		
Western Sandpiper (*Ereunetes mauri*)	5			
Sanderling (*Crocethia alba*)	2			5
Yellow-billed Cuckoo (*Coccyzus americanus*)	1			1
Belted Kingfisher (*Megaceryle alcyon*)		1		1
Eastern Kingbird (*Tyrannus tyrannus*)	2	1	1	15±
Least Flycatcher (*Empidonax minimus*)	10±			
Wood Pewee (*Contopus virens*)	10±•	3		15±•
Bank Swallow (*Riparia r. riparia*)	100±•			8•
Barn Swallow (*Hirundo rustica erythrogaster*)	300±•	10	50±	200±
Purple Martin (*Progne s. subis*)	40±•	1		5
Wood Thrush (*Hylocichla mustelina*)		1		
Veery (*Hylocichla fuscescens*)	1			
Red-eyed Vireo (*Vireo olivaceus*)	1			1
Black and White Warbler (*Mniotilta varia*)	10±		1	
Prothonotary Warbler (*Protonotaria citrea*)	1•		3	
Golden-winged Warbler (*Vermivora chrysoptera*)	1			1•
Parula Warbler (*Parula americana*)				1
Eastern Yellow Warbler (*Dendroica petechia aestiva*)	1•			
Magnolia Warbler (*Dendroica magnolia*)	50±			
Cerulean Warbler (*Dendroica cerulea*)				2•
Blackburnian Warbler (*Dendroica fusca*)			1•	
Yellow-throated Warbler (*Dendroica dominica*)	15±			
Oven-bird (*Seiurus aurocapillus*)	25±			5±
Northern Water-thrush (*Seiurus noveboracensis*)	50	1	2	50±
Kentucky Warbler (*Oporornis formosus*)	25±			
Hooded Warbler (*Wilsonia citrina*)	200±	15±		100±
American Redstart (*Setophaga ruticilla*)	5		3	5±
Baltimore Oriole (*Icterus galbula*)			1	
Summer Tanager (*Piranga r. rubra*)	2•	1		

• Specimen collected
± Conservative estimates

SUMMARY

From August 27 to September 3, 1952, a visit was made to the four small groups of islands known as Cayos Arcas, Arrecifes Triángulos, Cayo Arenas, and Arrecife Alacrán, which lie on the Campeche Bank between 80 and 100 miles from the mainland of the Yucatán Peninsula.

Thirty-six species of migratory birds were recorded from the islands (table 1). Migrants were particularly abundant on Cayos Arcas, and to a lesser extent on Arrecife Alacrán. Food is scarce and natural sources of fresh water are entirely lacking on the islands. On Cayos Arcas many species fed on houseflies, but swallows and martins appeared to be entirely without food. Mortality is undoubtedly high, but it is believed that where houseflies are available many birds live to reach the mainland.

The number of migrants seen over the open sea, all coming from due north, was impressive, although observations were made irregularly. Approximately half of the migrants appeared over the Campeche Bank between 8:00 and 10:00 a. m., while the remainder came at intervals throughout the day. Nothing is known of nocturnal migrants. During the peak period of the flight on the morning of August 28 it is estimated that the birds were passing at the rate of 137 per mile per hour. If the birds were approaching uniformly along the entire 500 miles of the Gulf coast of the Yucatán Peninsula, 68,000 migrants per hour were passing at the height of the daily flight. If the fall migration pattern which was observed during the trip is the normal one, it is calculated that approximately 137,000 birds arrive daily on the Peninsula. The length of the migration period is unknown, but it must last for at least one month. If flights as large as those observed occur on only 10 days, there would be a minimum autumnal migration of 1,370,000 birds. Although highly speculative, these estimates are probably not unreasonable and are undoubtedly very conservative.

The abundance of records of autumnal migrants in the open Gulf, the lack of meteorological conditions on the northern Gulf coast which could have "forced" migrants to sea, and the consistency in the direction and manner of flight point toward the normality of autumnal trans-Gulf migration.

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Peabody Museum of Natural History, Yale University, New Haven, Connecticut, December 8, 1952.

LETTER TO THE EDITOR OF THE AUK

Dear Sir:

Ornithologists whose memories go back four decades or more will recall with glee, the animated controversy, carried on through the pages of scientific literature, on the subject of concealing and revealing coloration. See particularly, 'The Auk' for 1911 (vol. 28). The chief disputants were a distinguished naturalist, who was also a former President of the United States, and a well-known nature artist. Others joined the discussion on both sides and even the Editor of 'The Auk' was constrained to participate.

The undersigned, authors of the paper "A Trans-Gulf Migration" (**Auk**, 69: 34–39), have no desire to amuse or entertain their colleagues by engaging in a similar controversy with Mr. George G. Williams of The Rice Institute, Houston, Texas. We are completely satisfied that great numbers of North American migratory birds regularly, both spring and fall, cross the Gulf of Mexico. Mr. Williams is of the contrary opinion, which is, of course, his privilege. In this, reference is made to his cleverly written paper in 'The Auk' for October, 1952 (pp. 428–432).

Evidence in support of the trans-Gulf concept is accumulating rapidly and will be judged on its own merits by students of bird migration. They will be interested to know that ornithological observations on the M-V Oregon in the Gulf of Mexico, are continuing, and much additional important data, covering the spring and fall migrations of 1952, are now at hand. As this letter is written (April 13), the vessel is again at sea with an interested and qualified bird observer aboard.

We do, however, wish to take this opportunity to correct one error in our paper above cited. The footnote to Table 2 (p. 36) states that "Specimens of those species marked by an asterisk were retrieved from the water by means of a dip net; the figure following in parenthesis is the number so recovered." The Vermilion Flycatcher (*Pyrocephalus rubinus*) is marked by an asterisk although there is no parenthetical number. Placing the asterisk before the name of this species was a typographical error that was not caught in correcting the proof. It was not in the original manuscript which is still in our possession. Although we are satisfied with the accuracy of the identification, it was entirely visual and is not backed up by the specimen. We will, therefore, be glad if all readers of 'The Auk,' make the necessary correction on page 36 of our paper.

HARVEY R. BULLIS, JR. AND FREDERICK C. LINCOLN,
Fish and Wildlife Service, Washington, D. C.

SEASONAL VARIATION IN TESTIS-STIMULATING ACTIVITY OF MALE PHEASANT PITUITARY GLANDS

BY FREDERICK GREELEY AND ROLAND K. MEYER

THIS paper is a study of seasonal pituitary-gonad relationships in game farm Ring-necked Pheasants (*Phasianus colchicus*). Investigations of the seasonal breeding physiology of birds have customarily been approached through study of gonadial activity. The data obtained in this way are abundant, but there is little information on the seasonal variation in gonadotrophic activity of the pituitary gland, measured by direct means. In this paper we shall present data from the bio-assay of gonadotrophin in dried pheasant pituitary gland collected monthly throughout the year.

Burger (1949) emphasized the need for further direct work on the pituitary gland as the master control of breeding activity. How closely the quantity of gonad-stimulating hormone produced by the pituitary gland follows the seasonal changes in gonadial activity has not been shown. Seasonal changes in the gonads may be due to parallel changes in pituitary pro luction of gonadotrophic hormone or may reflect changes in the sensitivity of the gonads themselves to this hormone. No data on the level of gonadotrophic hormone in the pituitary gland or the blood stream at various seasons of the year are available. However, the presence of gonad-stimulating substances in the pituitary gland has been demonstrated in most domestic birds, and Benoit (1935) demonstrated that the amount of these substances increased in the pituitaries of ducks which were subjected to increased day-length. Phillips (1942) found no gonad-stimulating activity in the pituitary gland of the Ring-necked Pheasant but did not state at what season the material was obtained. A higher level of pituitary gonadotrophin has been demonstrated in older and reproductively more active male chickens and pigeons than in younger, inactive individuals (Breneman, 1944; Kato, 1938; Schooley, 1937; Smith and Engle, 1927). In domestic hens, on the other hand, more pituitary gonadotrophin was shown in non-laying than in laying birds (Phillips, *op. cit.*; Riley and Fraps, 1942). The answers to some of these problems can be surmised from what is known, but direct evidence is fragmentary.

This study was supported by a grant-in-aid from the Wisconsin Alumni Research Foundation, and the birds and facilities of the Experimental Game and Fur Farm at Poynette, Wisconsin, were provided by the Wisconsin Conservation Department. Mr. Cyril

Kabat, Mr. Frank Kozlik, and the personnel of the State Game Farm contributed generously of their time. We also wish to thank Mrs. Frederick Greeley for her interest in and help with the laboratory work and Dr. John Neess for his advice in the use of the statistical techniques.

MATERIALS AND METHODS

The pheasants used in this study were pen-reared. For each of 12 months a dozen birds of each sex were transported on the day of autopsy from the State Game Farm at Poynette, Wisconsin, to the laboratory, a distance of 25 miles. All birds were sexually mature (9 to 24 months). They were decapitated, and the endocrine organs were weighed on a torsion balance to the nearest 0.5 mgm., or, in the case of heavier organs, on a gram balance. After weighing, each pituitary gland was crushed between two glass slides, air dried, and stored at room temperature. Only anterior lobes were used. Subsequently, all of the pituitary material from a given sex and month was scraped from the slides into a mortar and ground to a fine powder. The powder was stored in a corked vial placed in a desiccator in darkness at room temperature. When material for the entire year had been collected, it was assayed for testis-stimulating potency in one-day-old male chicks from a redbar strain (Lloyd and Hill, 1946). The pituitary powder was suspended in an aqueous solution then injected subcutaneously twice daily for 4.5 days. Each chick received a total of 2.0 mgm. of pituitary powder. Therefore, all comparisons were made on the basis of hormone concentration in 2.0 mgm. of dried pituitary. The changes which occur are the same when the data are calculated as the amount of hormone per pituitary gland as they are when expressed as concentration in the dried tissue. The chicks were sacrificed 24 hours after the last injection, and the testicular and body weights recorded. This technique measures primarily the follicle-stimulating hormone (FSH).

The dried weight of the pituitaries was low in winter, so the powdered samples were pooled by pairs of months as follows: September-October, November-December, and January-February.

The basic statistical methods used in the study are those of Snedecor (1946). A significant positive correlation was found between the body weights and testis weights of the assay chicks, and the regression line of one on the other was calculated. The variation of the testicular weights from the regression line was used as a measure of the response to the pituitary preparations. The original variation in the raw data is not limited by this method as it is when organ weights are expressed as a ratio of body weight.

A detailed examination of the histology of the testes of the donor pheasants was not made except during periods of rapid change in weight. Testes were sectioned at six micra and stained with Harris' haematoxylin. All testes from the donors of pituitaries in January and five from donors in February, including the heaviest (1.125 gms.) and the lightest (0.263 gms.), were examined. It was assumed, because of their large size (0.784 to 11.7 gms.), that most of those from donors in March, April, May, and June were producing mature sperm,

TABLE I

PITUITARY GONADOTROPHINS AND TESTIS WEIGHT OF PHEASANTS AT DIFFERENT SEASONS AND DAY-LENGTHS

	Gonadotrophic Activity			*Testis Weight (in gm.)*		
Date	*Number of Chicks*	*Testis Response (in mgm.) Mean ± σ_m*	*Number of Pheasants*	*Mean ± σ_m*	*Including Civil Twilight (Hrs.:mins.)*	*Day-length*
Jan. 20	9	9.0* ±1.3	12	0.2233 ±0.0738	0.32 ±0.05	10:36
Feb. 20			12	0.4138 ±0.0649		11:47 } 11:10
Mar. 20	6	14.5* ±1.5	12	4.0866 ±0.7150		13:04
Apr. 16	6	18.1* ±3.7	12	8.2167 ±0.5490		14:28
May 18	7	18.0* ±2.9	11	8.1364 ±0.5346		15:54
June 19	5	15.7* ±3.2	12	5.7583 ±0.6075		16:36
July 20	4	2.3 ±1.0	12	1.7178 ±0.2434		16:06
Aug. 19	6	6.6 ±1.7	12	0.2944 ±0.0136		14:49
Sept. 20	9	11.7* ±2.3	12	0.3364 ±0.0194	0.236 ±0.0122	12:13
Oct. 17			10	0.2488 ±0.0141		11:58 } 12:05
Nov. 19	5	8.7* ±1.5	12	0.1797 ±0.0121	0.180 ±0.0098	10:40
Dec. 20			12	0.1825 ±0.0126		10:09 } 10:24

* Significantly different from uninjected chicks.
σ_m Standard error of the mean.

but no histological study was made of these testes. Five testes from July, including the heaviest (3.5 gms.) and lightest (0.287 gms.), and all of those from August were sectioned. All preparations were examined at 900× under oil immersion and classified by stages according to Blanchard (1941) and Blanchard and Erickson (1949). Testes from a group of 12 juveniles and 12 adult male pheasants from the game farm sacrificed on October 1 the year following the study were examined for age differences.

RESULTS

The data for cock pheasant pituitary gonadotrophin are shown in table 1 and in figure 1, with the mean gonadial weight of the donor pheasants for each month. The spermatogenic status of the pheasant testes was determined by histological examination in some cases and assumed in others. The period during which spermatozoa were observed or assumed to be present in the seminiferous tubules is

indicated in figure 1. The values plotted for gonadotrophic potency are the mean differences between uninjected assay chicks and those receiving pheasant pituitary powder.

Cock pheasants from the game farm were sacrificed for the first time on July 20, 1947, when their testes were rapidly involuting. Spermatozoa were still present in three of the five testes examined but not in the two lightest. The pituitary glands at that time were at their minimum gonad-stimulating potency for the 12 months studied.

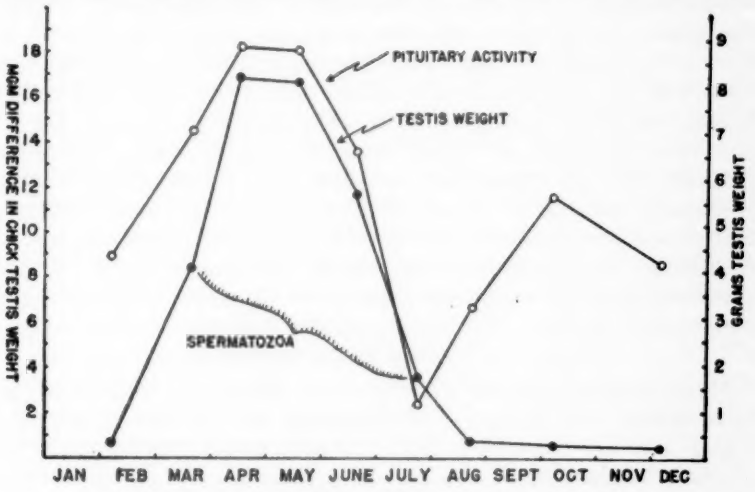
MGM DIFFERENCE IN CHICK TESTIS WEIGHT
GRAMS TESTIS WEIGHT
PITUITARY ACTIVITY
TESTIS WEIGHT
SPERMATOZOA
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC

FIGURE 1. Activity of Testis and Pituitary in Pheasants.

A slight increase in potency was found in August when all the testes were in late regression. Pituitaries taken from birds in September and October produced a statistically significant increase in the testes of the assay chicks. The material from both winter groups (November-December and January-February) was significantly active though slightly less so than material from birds in September and October. In November and December, the weights of the donors' testes were minimal. There may still have been some activity in the interstitial cells, but no histological data are available. The presence of primary spermatocytes in adult pheasants has been observed throughout the year (Hiatt and Fisher, 1947). In this study, testes from pheasants obtained in January and February showed some activity, those from January having reached Blanchard's stages two and three (a few primary spermatocytes and occasional Leydig cells) and those from February, stages three and four (some tubules with synaptic primary spermatocytes and increase in Leydig cell development).

In the spring and early summer months the potency of pituitary material varied directly with gonadial weight: both reached a maximum in April and May and decreased during June and July. The testes examined in July were still in Blanchard's stage 7 (full spermatogenesis) or early regression, although average weights had declined markedly. Widespread involution of tubular tissue and pyknosis of interstitial cell nuclei were evident in the smallest testes.

A study of hen pheasants was carried out simultaneously and in a similar manner except that no histological work was done. During the spring egg-laying period, the pituitaries were collected on the basis of the number of eggs laid: those birds which had laid one egg, those which had laid more than 30 eggs, and those which had ceased laying. In addition on July 20, a mixed group of game farm hens was collected, some of which were still laying. Hen pituitaries generally were not as potent as cock pituitaries: significant stimulation of domestic chick testes was obtained only from the January-February, March, and June pituitary preparations. Pituitary glands collected in April from hens which had laid but one egg (and in some cases ovulated a second) gave no significant stimulation of chick testes with the 2 mgm. dose used.

DISCUSSION

Most investigations of pheasant reproduction have divided the behavioristic and physiological processes into phases. Hiatt and Fisher (*op. cit.*) described three phases based primarily on testis weight. The processes involved are continuous so that partitioning of them into phases is a superficial but necessary technique for describing the observations. We shall discuss in order (1) the breeding season, (2) the post-reproductive season, and (3) the fall recovery and winter seasons.

The breeding season.—Two problems suggested by the data described in this paper and other data on the reproductive season of birds are: (1) the relationship of measured endogenous gonadotrophin to the function of the testes of the donor birds; and (2) the relationship of environmental stimuli to the production and secretion of pituitary gonadotrophin. In this study, the close parallel between gonadotrophic content of the pituitary gland and the function of the testes of the donor pheasants (based primarily on weight) indicates that gonadotrophin was entering the blood in direct proportion to the amount in the pituitary gland. Hence, when the gonadotrophic content increased in March, there was a concurrent advance in testicular weight. Both remained high in April and May. This relationship held for other phases of the reproductive cycle, although at lower levels of gonadotrophin the rate of recrudescence of the testes was slower.

Pheasants are capable of breeding any time from October to June (Bissonnette and Csech, 1937) and perhaps at other times of the year under proper manipulation of day-length. Bissonnette and Csech (*op. cit.*) found 14 hours of artificial and natural light per day for eight days in early October sufficient to cause an immature cock pheasant to tread immature hens which produced fertile eggs in November. They were able to obtain fertile eggs from November through March by increasing day-lengths. In our data, the first major increase in pituitary gonadotrophin and in testicular weights over winter levels was from January-February to March when the days, including Civil Twilight, were from 11.2 to 13.1 hours long (Suppl. to the American Ephemeris 1946, U. S. Naval Observatory). A 62 per cent increase in the level of gonadotrophin and a 1200 per cent gain in mean testis weight were associated with these day-lengths in March. Although day-length continues to increase until late June, the amount of gonadotrophin in the pituitary apparently reaches its maximum by April and decreases in June. The nature of pituitary function during the long days of summer is not well understood but probably is related to what has been called the "refractory state" of the testes, and/or the pituitary gland, by many writers (Bissonnette, 1937).

The post-reproductive period.—This period begins in June. The quantity of gonadotrophin in the pituitary was the same in April and May; June was the first month in which a decline was evident. The pituitary gonadotrophin decrease 12.5 per cent from May to June and 87 per cent from May to July (table 1). A simultaneous decline of 79 per cent in mean testis weight occurred in the latter period. We can reasonably conclude that the decline in the production of gonadotrophic hormone brings about gonadial involution in game farm pheasants whether or not the testes still are sensitive to gonadotrophin during this period.

Other investigators have clearly shown that the species of birds which can be brought into reproductive condition by increased day-lengths cannot be maintained in this condition. Involution of the testes ultimately occurs and molting follows in spite of continued long days. A drop in mean testicular weight and molting occurred in June in our experimental cock pheasants, although day-lengths were far in excess of those which produced an increase in March.

Various writers have suggested explanations for the cyclic regression of activity in the gonads. Several investigators have proposed an inherent cycle: most recently Wolfson (1952) writes of the inherent rhythm as an alternation of activity and inactivity, the rate, amplitude, and duration of which is controlled by day-length.

Several agents have been observed to alter the reproductive cycle of birds. Thyroxin accelerates the reproductive cycle of English Sparrows, *Passer domesticus* (Miller, 1935), producing premature regression; adrenalin inhibits the effect of light or causes regression in English Sparrows (Perry, 1941; Lyman, 1942); and prolactin causes regression of testes in the chicken and pigeon (Bates, Lahr, and Riddle, 1935; Bates, Riddle, and Lahr, 1937) and inhibits gonadial development in White-crowned Sparrows, *Zonotrichia leucophrys* (Bailey, 1950). Selye (1946) suggests that environmental stress stimulates the secretion of adrenocorticotrophic hormone (ACTH) by the pituitary gland while at the same time suppressing the output of gonadotrophin. Whatever the phenomenon associated with regression of pituitary gonadotrophin and the testes, it is clear that we need more direct evidence of the levels of the other pituitary hormones (thyrotrophin, ACTH, prolactin) during the course of the reproductive cycle. Not until then can we understand the nature of the rhythm whether inherent or otherwise.

The duration of the refractory period of pheasants under normal seasonal day-lengths is not well established. In this study gonadotrophic content of the pituitary was greater, but not significantly so, on August 19 than at the low point on July 20. The combined September-October sample contained significant amounts of gonadotrophin. Thus, the pituitary gland of adult male pheasants may be sensitive to day-length by the latter period if not before. The work of Bissonnette and Csech (*op. cit.*) demonstrated that immature pheasants were sensitive by October, but data on the testes of pheasants taken by Hiatt and Fisher (*op. cit.*) indicate that the testes of adults do not undergo spermatogenesis in fall while the testes of juvenile birds sometimes do. We have similar data for pheasants, but not from those from which pituitaries were taken.

The fall resurgence and winter period.—The resurgence of reproductive activity in fall among pheasants and other birds is well known. Significant amounts of pituitary gonadotrophin similar to those in the September-October sample were also found during the winter months, but this was not reflected in a mean increase in testicular weight until January. It should be noted that the slow growth of the testes from November through February is associated with gonadotrophic levels only half those of April. In early October, the testes of pheasants which we have examined histologically show considerable advancement over those taken in August. We suggest that these moderate levels of pituitary secretion produce a slow development of the testes.

Wolfson (*op. cit.*) pointed out that nine hours of day-light were

sufficient to produce spermatogenesis in Slate-colored Juncos (*Junco hyemalis*) in 11 months, and it is to be emphasized that the pheasants used in our study were subject to not less than 10 hours of light per day (including Civil Twilight) throughout the winter. Moderate levels of pituitary activity are associated with these day-lengths in pheasants.

SUMMARY

Dried pituitary glands of sexually mature game farm pheasants sacrificed during 12 months of the year were assayed for their gonadotrophic hormone content as determined by bio-assay in one-day-old male domestic chicks. The testicular weights of the male pheasant donors followed closely the fluctuations of pituitary gonadotrophic content from late winter to mid-summer.

A decline in amount was underway by June 20, so it was reasoned that the pituitary gland was refractory to day-length by that time. The decrease in the production of gonadotrophic hormone was accompanied by a decline in testis weight with complete involution in July and August. Production of gonadotrophin appeared to increase in August, and reached statistically significant levels in combined dried pituitaries taken in September and October.

No weight increase of the pheasant testes was found in fall and winter although appreciable amounts of gonadotrophin were present in the three samples taken in September-October, November-December, and January-February. No histological study of donors' testes taken in the fall and early winter was made; but testes of non-donor birds killed October 1 had reorganized tubular and interstitial tissue, and testes from the donors of January 20 contained active Leydig cells. The data indicate that day-lengths of this period are sufficiently long to maintain moderate pituitary gonadotrophic production which may act slowly on the testes.

The cyclic nature of reproduction in pheasants and other birds was discussed in relation to the effect of light on the production of gonadotrophins by the pituitary gland. It was emphasized, however, that more information concerning the seasonal fluctuation of other pituitary hormones is needed before adequate evaluation can be made of the rôle of the environment in the control of reproduction, especially the refractory phase of the cycle.

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Departments of Wildlife Management and Zoology, University of Wisconsin, Madison, July 14, 1952.

TWENTY-EIGHTH SUPPLEMENT TO THE AMERICAN ORNITHOLOGISTS' UNION CHECK-LIST OF NORTH AMERICAN BIRDS[1]

THIS supplement covers actions of the Committee on Classification and Nomenclature relative to changes in name and status, as well as additions, which have been accepted to the end of the year 1952. The Committee held sessions during the meeting of the A.O.U. in Baton Rouge, and has conducted much additional business through the circulation of memoranda. The revision of ranges for the fifth edition of the Check-List has now advanced into the final family, the Fringillidae. There remains a considerable volume of work to be done on the many corrections received from collaborators.

We record with sadness the death on April 19, 1952, of James Lee Peters, whose work as a member of our committee had always been of immeasurable value.

Committee
- ALEXANDER WETMORE, Chairman
- HERBERT FRIEDMANN, Vice-Chairman
- FREDERICK C. LINCOLN
- ALDEN H. MILLER
- JOSSELYN VAN TYNE
- JOHN T. ZIMMER

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3. *Colymbus auritus* becomes *Colymbus auritus cornutus* Gmelin, through recognition of an American race distinct from the Old World race. American Eared Grebe. *Colymbus cornutus* Gmelin, Syst. Nat., vol. 1, pt. 2, 1789, p. 591. (Hudson Bay.) See Parkes, Condor, vol. 54, no. 5, September 22, 1952, pp. 314–315.

6. *Diomedea cauta cauta* Gould. Tasmanian White-capped Albatross. [83.1.] *Diomedea cauta* Gould, Proc. Zool. Soc. London, 1840 [July, 1841], p. 177. (Bass Strait, Australia.) Additional species. Seas near Australia; breeding on Albatross Island, Bass Strait, and wandering in the southern Pacific Ocean. Accidental at sea, about 39 miles off the mouth of the Quillayute River, Washington. See Slipp, Auk, vol. 69, no. 4, October, 1952, pp. 458–459, pl. 16.

13. *Oceanodroma tethys tethys* (Bonaparte). Galápagos Storm Petrel. [106.3.] *Thalassidroma tethys* Bonaparte, Tagebl. Deutsch. Naturf. Aerzte (Wiesbaden), Beilage no. 7, 1852, p. 89. (Galápagos Islands.) Additional species. Breeds in the Galápagos Islands, ranging at sea south to the latitude of northern Perú, and north to that of southern Baja California. Accidental at Melpomene Cove, southern end of Guadalupe Island, Baja California. See Huey, Auk, vol. 69, no. 4, October, 1952, pp. 460–461.

[1] The Twenty-seventh Supplement was published in The Auk, Vol. 69, No. 3, July, 1952, pp. 308–312.

31. *Botaurus lentiginosus*, formerly accepted as based on *Ardea lentiginosa* Montagu, Suppl. Orn. Dict., 1813 (preface dated June), not paged, is now taken from the earlier description by Rackett of the same specimen: *Ardea lentiginosa*, in Pulteney, Cat. Birds, Shells, and some of the more rare Plants of Dorsetshire, second edition (enlarged), May, 1813, p. 14. (Parish of Piddleton, Dorsetshire, England.) The name will be cited as *Botaurus lentiginosus* (Rackett), with the reference as given above. See Macdonald and Grant, Bull. Brit. Orn. Club, vol. 71, no. 5, June 22, 1951, p. 30.

60. *Mergus serrator major* Schiøler, accepted in the Twenty-fourth Supplement, Auk, vol. 66, no. 3, July, 1949, p. 282, is renamed *Mergus serrator schiøleri* by Salomonsen, Dansk. Orn. For. Tidsskr., vol. 43, pt. 2, June, 1949, p. 186, since *M. s. major* Schiøler, 1925, is antedated by *Mergus major* Sprüngli, 1784, and *Mergus major* Dubois, 1860.

83. *Lagopus lagopus muriei* Gabrielson and Lincoln. Shumagin Willow Ptarmigan. [301*f*.] *Lagopus lagopus muriei* Gabrielson and Lincoln, Proc. Biol. Soc. Washington, vol. 62, December 22, 1949, p. 175. (Nagai Island, Shumagin Islands, Alaska.) Additional subspecies. Aleutian Islands from Atka to Unimak; the Shumagin Islands; and Kodiak.

87. *Alectoris graeca* (Meisner). Chukor Partridge. [288.2.] *Perdix graeca* Meisner, Syst. Verz. Vög., 1804, p. 41. (Greece.) Introduced species. Now established in Washington, Idaho, California, Nevada, Arizona, and Colorado and introduced elsewhere. Found native as a species from southern Switzerland, Hungary, the Caucasus, Transcaspia, Tibet, Mongolia, and Manchuria south to Italy, Greece, Asia Minor, Iran, Chinese Turkistan, and Nepal. (Several subspecies have been included in the introduced stock in different localities.)

117. *Totanus totanus robustus* Schiøler, Iceland Redshank, becomes *Totanus totanus totanus* Linnaeus. Continental Redshank. *Scolopax totanus* Linnaeus, Syst. Nat., ed. 10, vol. 1, 1758, p. 145. (Europa = Sweden.) See Salomonsen, Grønlands Fugle, pt. 3, 1951, p. 567, where a specimen of the typical form is recorded. The record of *T. t. robustus* was based on two specimens reported by Helms but not subspecifically identified and apparently not preserved.

146. *Cepphus grylle mandti* becomes *Cepphus grylle mandtii* to conform with the original spelling.

197. *Dendrocopos pubescens gairdneri* becomes *Dendrocopos pubescens gairdnerii* to conform with the original spelling.

209. *Empidonax griseus* Brewster becomes *Empidonax wrightii* Baird, since the type specimen of the latter proves to be an example of the Gray Flycatcher. See Phillips, Auk, vol. 56, no. 3, July, 1939, p. 311.

209. *Empidonax wrightii* of the fourth edition of the Check-List becomes *Empidonax oberholseri* Phillips. Wright's Flycatcher. *Empidonax oberholseri* A. R. Phillips, Auk, vol. 56, no. 3, July, 1939, p. 311. (Hart Prairie, San Francisco Mountain, Arizona.)

230. *Parus carolinensis atricapilloides* Lunk. Northwestern Carolina Chickadee. [736*d*.] *Parus carolinensis atricapilloides* W. A. Lunk, Wilson Bull., vol. 64, no. 1, March 15, 1952, p. 19. (10 miles south of Arnett, Ellis County, Oklahoma.) Additional subspecies. Southern Kansas through Oklahoma to central Texas.

259. *Hylocichla ustulata almae* Oberholser, accepted in the Nineteenth Supplement, Auk, vol. 61, no. 3, 1944, p. 457, is found to be inseparable from *H. u.*

swainsoni (Tschudi), and is now relegated to synonymy. See Godfrey, Canadian Field-Nat., vol. 65, no. 5, September–October, 1951, pp. 172–174.

259. *Hylocichla ustulata incana* Godfrey. Yukon Olive-backed Thrush. [758*c*.] *Hylocichla ustulata incana* W. E. Godfrey, Canadian Field-Nat., vol. 65, no. 5, September–October, 1951, p. 173. (Lapie River, Canol Road mile 132, Yukon Territory.) Additional subspecies. Breeds in eastern Alaska, southern Yukon Territory, northern British Columbia, and north-central Alberta. Migration and winter range not recorded.

273. *Sturnus vulgaris zetlandicus*, recently accepted as accidental in eastern Greenland, is dropped from the list, since the specimen in the British Museum (Natural History) proves to be *Sturnus vulgaris vulgaris*. See Salomonsen, Grønlands Fugle, pt. 3, 1951, p. 575.

319. The reference to the original description of *Hesperiphona vespertina montana*, listed from Ridgway, 1874, is corrected to read R. Ridgway, Bull. Essex Inst., vol. 5, November, 1873, p. 189. The type locality remains Mirador, near Vera Cruz, México. See Zimmer, Auk, vol. 70, no. 2, April, 1953, p. 213.

330. *Pipilo erythrophthalmus rileyi* Koelz. Riley's Eastern Towhee. [587*c*.] *Pipilo alleni rileyi* W. Koelz, Proc. Biol. Soc. Washington, vol. 52, July 22, 1939, p. 121. (Brunswick, Georgia.) Additional subspecies. Southeastern North Carolina, along the coast to northern Florida, and west through southern Georgia to southeastern Alabama. See Dickinson, Bull. Mus. Comp. Zoöl., vol. 107, October, 1952, pp. 299–303.

332. The number for *Pipilo fuscus mesatus*, omitted inadvertently in Supplement Twenty-seven, is 591*i*.

353. *Passerella iliaca swarthi* Behle and Selander. Utah Fox Sparrow. [585*q*.] *Passerella iliaca swarthi* W. H. Behle and R. K. Selander, Journ. Washington Acad. Sci., vol. 41, no. 11, November 14, 1951, p. 364. (2 miles west of Eden, at 5,200 feet elevation, on North Fork of Ogden River, Utah.) Additional subspecies. Breeds in mountains from Owyhee, Bannock, and Bear Lake counties, southern Idaho, to Juab, Sanpete, and Wasatch counties, northern Utah; winter range not known.

374. *Spinus notatus* (DuBus), of the hypothetical list, is identified as *Spinus magellanicus ictericus* (Lichtenstein). Brazilian Siskin. *Fringilla icterica* Lichtenstein, Verz. Doubl. Berliner Mus., 1823, p. 26. (São Paulo, Brazil.) The bird is native in southeastern Brazil, eastern Paraguay, and northeastern Argentina. The specimen, collected by Audubon at Henderson, Kentucky, is supposed to be an escape from captivity, so that the species remains in the hypothetical list. See Todd, Ann. Carnegie Mus., vol. 17, June 9, 1926, pp. 57–58.

GENERAL NOTES

What Bird Lays Black Eggs?—It has been stated that the honeycreepers of the genus *Cyanerpes* "are the only birds in the whole world that lay black eggs" (Penard, 1910: 477). Such almost solidly black or purplish-black eggs, attributed to this genus, have been collected in northeastern South America—Surinam (Penard, 1910: 475–477), British Guiana (Beebe, 1917: 241–242), Venezuela, Trinidad (Belcher and Smooker, 1935: 19), and Brazil (Snethlage, 1937: 517–518). The nest in each case has been described as a thin-walled, closed bag or pouch, with the entrance to the side, composed of blackish fibres, and hanging over water. Reported egg measurements vary only slightly, from 18.9–21.9 × 13.3–15 mm. (*op. cit.*: Hellebrekers, 1942: 272).

Beginning with the first edition of Nehrkorn's egg catalogue (1899), which figured the black egg, these eggs have been regularly attributed by collectors to the Red-legged or Blue Honeycreeper (*Cyanerpes cyaneus*), which ranges north to Mexico, and to its congener, the South American Yellow-legged or Purple Honeycreeper (*C. caeruleus*)—both of which were formerly placed in the genus *Coereba*. The correctness of this attribution has occasionally been questioned (Ihering, 1900: 209; Hellebrekers, 1945: 99). Long ago, a nest of *C. cyaneus* from Cuba had been described as an open cup, and the egg as whitish with lilac and reddish-brown spots (Thienemann, 1857: 152; Gundlach, 1876: 102), and from Brazil a similar whitish, vinaceous-spotted egg had been reported as taken with the parent birds (Allen, 1891: 348). Nehrkorn himself, in the second edition of his egg catalogue (1910: 324, pl. III, f. 26), changed his opinion and assigned the black eggs to the Green Honeycreeper (*Chlorophanes spiza*), describing eggs of *Cyanerpes cyaneus* from Cuba and of *C. caeruleus* from Venezuela and Bolivia as whitish with gray to brownish spots.

Nevertheless, the attribution of the black eggs to *Cyanerpes* has continued to receive general currency, probably because of the seemingly circumstantial account in the Penards' valuable book, "De Vogels van Guyana" (1910: 475–477). Only recently has it become widely known that the Penards' entire egg collection was derived from hunters, Indians, and the like, and that their identifications were not based on personal field experience, as they were confined to their house in town from early boyhood by reason of leprosy (Haverschmidt, 1949: 56–60). Beebe's eloquent description (accompanied by a photograph) of a pensile nest with black eggs, taken in British Guiana, which he assigned to *C. cyaneus* (1917: 241–242), has been quoted at length in Chubb's "Birds of British Guiana" (1921: 481).

Yet observations of active field ornithologists now resident in the tropics establish beyond question that *Cyanerpes* does *not* build bag nests nor lay black eggs. Dr. Alexander Skutch, who has studied the life history and found many nests of *C. cyaneus* in Costa Rica, writes me that the nests are shallow cups, and the eggs whitish with brown spots. Dr. Miguel Alvarez del Toro of Chiapas, Mexico, independently has published a description and photograph showing a cup nest containing white eggs, finely spotted with reddish-brown and grayish (1952: 18, f. 12). Dr. Francois Haverschmidt of Surinam observes (*in litt.*) that in his experience *C. cyaneus* is a bird of second growth and clearings, not likely to require as its nesting site a riparian habitat, such as has been described by the collectors of the black eggs. My own observations of this common species in Panama are in complete agreement with Haverschmidt.

Nehrkorn's later allocation of the black eggs to *Chlorophanes spiza* also turns out to be wrong, for Skutch writes me that *Chlorophanes*, too, lays whitish, brown-spotted, eggs in a shallow cup nest.

The identity of the remarkable black eggs thus remains a mystery, though we know the nest, the habitat, and, in a general way, the South American range. We also have some indication of the breeding season, for Surinam eggs in the Penard collection were taken in May (Hellebrekers, 1942: 273), and those reported from British Guiana, Trinidad and Venezuela, in July. Judging by the number of such black eggs reported, the species cannot be rare. It is quite possible that the bird laying the eggs is streaked and olivaceous in color, like the female of *Cyanerpes*. The suspicion arises that a member of the Tyrannidae may prove to be responsible. What is needed is careful observation, rather than assumption based upon published identifications.

I am indebted to W. Ph. J. Hellebrekers of Leiden, The Netherlands, whose revisions of the Penard oölogical collection called the problem to my attention; to the German oölogist Max Schönwetter for a number of literature references; and to Alexander Skutch, Miguel Alvarez del Toro, and Francois Haverschmidt for giving me the benefit of their views and field experience.

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—Eugene Eisenmann, *Linnaean Society of New York, New York.*

Occurrence of an African Cattle Egret (*Ardeola ibis ibis*) in Massachusetts.—A male of this old world species was taken in Wayland, on April 23, 1952. It represents, we believe, the first North American specimen record.

The specimen (Museum of Comparative Zoology No. 279088) has been compared with a good series in that Museum. It matches in detail the breeding plumage of *Ardeola ibis ibis* (L.), and the soft parts of the living bird corresponded to the description of that subspecies. The iris was yellow, face orange-yellow, bill orange, legs yellow-green, feet black-olive, and there was a narrow red band at the edge of the feathers at the upper end of the leg. Stomach contents consisted of a frog and a number of insects; a few bird lice were collected and preserved. The testes measured 3 x 4 mm.; we found no evidence of any pathological condition.

In the most recent revision of the species, Dr. Finn Salomonsen (Proc. Zool. Soc. London, p. 221–222, 1934) points out that the subspecies are easily distinguished in the nuptial plumage. As he says, "In the breeding plumage *coromandus* has head, neck, throat, fore neck, and the ornamental plumes on back and crop vivid golden or rusty cinnamon, whereas *A. i. ibis* has the throat and fore neck white, the crown, hind neck, and the dorsal and pectoral plumes orange to pale pinkish-buff." In this paper he describes a new subspecies, *A. i. seychellarum*, which he characterizes as follows: "The throat and fore neck are white as in *A. i. ibis*, but the crown and the dorsal and ventral elongated feathers are golden-cinnamon as in *coromandus*. . . . More striking, however, are the very small measurements of *seychellarum*." He quotes the following measurements of male birds: *A. i. ibis*, wing length, 245–265 mm.; and *A. i. seychellarum*, wing length, 230–237 mm.

The throat and fore neck of our bird are white; the crown, hind neck, dorsal and ventral ornamental plumes are a pastel pinkish-buff. This color matches perfectly that of the African series. The fore wing length of our bird, however, is 236 mm. (measured flattened). This would tend to include the bird in the small, Indian Ocean-area subspecies, *A. i. seychellarum*. The specimen in no way resembles this race in plumage, and on the basis of distribution this race is especially unlikely because it is separated from North America by the African race, *A. i. ibis*, on the west and by the east Asian race, *A. i. coromandus*, on the east. Wing measurements of 13 specimens in the Museum of Comparative Zoology from the Blue Nile area, Tanganyika, Rhodesia, and Cameroons show a variation from 241 mm. to 255 mm. and Salomonsen (*loc. cit.*) shows variation on up to 265 mm. On the basis that this character seems variable and that our bird is 5 mm. under the lower limit, we have decided that this measurement is remarkable but not of sufficient importance to throw doubt on the subspecific identification. Blake's record (Auk, 56: 470–471, 1939) of a female from Buxton, British Guiana, gives a measurement of 244 mm. for the first western hemisphere specimen. Dr. Robert Storer reports that the specimen at the University of Michigan Museum of Zoology, Ann Arbor, taken by Fr. Haverschmidt in Surinam, March 30, 1947, is a male with the nuptial plumes light. The wing measures 241 mm. All these measurements are below the mean and average of African specimens, but any statistical treatment of the few specimens available would be misleading, we feel.

We refer the species to the genus *Ardeola* as did Salomonsen (Bull. Mus. Hist. Nat. Paris, pp. 347–357, 1929, and *loc. cit.*) and Witherby *et al.* (The Handbook of British Birds, III: pp. 142–144, 1939). It should be pointed out that J. L. Peters (Check-list of the Birds of the World, I: 108, 1931) maintained a separate genus, *Bubulcus*, for this species after the publication of Salomonsen's article (*loc. cit.* 1929) in which the uniting of *Bubulcus* with *Ardeola* was proposed.

The question of the origin of the bird was at once raised and the suggestion made that it was an escaped bird. We knew of no other appearance of the species at the time of collection and to investigate all alternatives sent inquiries to all possible sources of escaped birds. No one had lost such a heron. Mr. Lee Crandall of the New York Zoological Park reported that they had had no Cattle Egrets since 1945; Dr. Mann of the National Zoological Park in Washington, D. C., reported no record of ever having had the species. The Franklin Park Zoo in Boston, Chase Wild Animal Farm in Egypt, Mass., Meems Brothers and Ward in Sparkill, New York, Mr. Ruhe of New York City, and Trefflich's Bird and Animal Company of New York all returned negative answers to our inquiries about the bird.

The flight feathers and long slender toe claws of the specimen are in perfect condition, indicating strongly that the bird had not been closely imprisoned or been in a screened or other than earth-floored cage. This in itself constitutes only negative evidence that the bird wandered to this continent under his own power. But it seems to us that in the last few months very positive evidence has been collecting, in the form of at least two subsequent sight records further south along the coast, and another specimen from Massachusetts. At least thirteen birds had been seen by July, 1952, when this article was submitted for publication. These records will be published without doubt, and they combine to offer evidence of a major influx of the species into North America. It would be ludicrous at this point to suggest, under the plea of caution, that these are all escaped birds.

The present invasion is a strong indication of how the species may have become established in northern South America, and it may be that they will become established on this new continent. Fr. Haverschmidt of Paramaribo, Surinam (Dutch Guiana), has discussed the occurrence of the species, its spread, and the probability of its arrival in South America by an explosive emigration (Auk, 67: 380–381, 1950). He refers to other notes in 'The Auk' on the occurrence of this bird in British Guiana and Venezuela and says that it is obvious that the bird is spreading and establishing itself in the lowlands of northern South America. Phelps (Boletin Soc. Venezolana de Ciencias Naturales, X, No. 67: 230–231, 1946) quotes from a letter from a planter, Mr. Hunter, at Versailles (on the right bank of the Demarara River), British Guiana, who has observed flocks of Cattle Egrets in that area since 1930. The bird was found by Mr. Ludlow Griscom of Cambridge who visited British Guiana in February 1937 and saw, with Mr. P. B. Peberdy and Mr. J. P. Jack, a flock of them near Georgetown. Drury, while on duty with the Navy between Trinidad and the Guianas in 1944, found the bird to be common at Paramaribo, Georgetown, and as far up the Essiquebo River as they went. The bird was so common that the local people had a common name for it—Squacco Heron—(which is used elsewhere to refer to *Ardeola ralloides*). The species had spread west to the state of Guarico, Venezuela, as reported by Phelps (Auk, 61: 656, 1944), and in 1944 Drury saw the species at Aruba, Netherlands West Indies.

The weather of the week before the appearance of our bird in Massachusetts was essentially clear with strong southwest winds all over the western Caribbean area. There was a disturbance over the southern Great Plains turning northeast over New Orleans, Louisiana. There was no storm, but a strong tail-wind for any bird starting off in a northeasterly direction and no reason for the bird to stop. It is not clear that these weather conditions contributed actively to the appearance of our bird because we do not know how long the bird had been in North America or when the other individuals since recorded arrived. It is entirely possible that there has been a steady drift of birds moving into the northern regions.—WILLIAM H. DRURY, JR., ALLEN H. MORGAN, AND RICHARD STACKPOLE, *Cambridge and Wayland, Massachusetts.*

White-winged Scoter Nesting Record in North Dakota.—The White-winged Scoter (*Melanitta deglandi*) has been recorded in North Dakota a number of times, but nesting records are rare. The last nesting (to the writer's knowledge) was reported on July 28, 1936, by Seth Low who found two broods of nine young each, near Denbigh, North Dakota (Auk, 63: 251–252, 1946). Although a pair of White-winged Scoters was observed on School Section Lake, in the Turtle Mountains of North Dakota, on June 10, 1952, by D. V. Gray of the Lower Souris National Wildlife Refuge, no brood was seen on subsequent visits (Audubon Field Notes, 6: 287, 1952).

On July 28, 1952, while making an aerial waterfowl census on the Des Lacs National Wildlife Refuge, Kenmare, North Dakota, U. S. Fish and Wildlife Service Pilot-Biologist R. M. Glahn and the writer observed what they believed to be a female White-winged Scoter with a brood of downy young. Although several passes were made at a low altitude, it was not possible to count the young accurately.

In the early morning of July 29, the brood was re-located and the identity checked by the writer. There were then nine downy young with the female White-winged Scoter.

On the evening of July 29, the brood was again observed and the identification was verified by Dr. and Mrs. R. T. Gammell of Kenmare, North Dakota. At this time, however, only eight young were seen.

The last observation of this White-winged Scoter and her brood was made on September 3, by K. D. Dybsetter of the refuge staff. At this time only three young, about two-thirds adult size, remained.

Although the Upper Des Lacs Lake area frequented by the female and her brood was covered several times while making population counts, breeding-pair counts, and early brood counts, the male scoter was never seen.

Kortright (The Ducks, Geese and Swans of North America, 1943) indicated that northern North Dakota is within the breeding range of the White-winged Scoter, and it seems probable that the species nested more extensively in this area in earlier days; encroachment of civilization and past drought years may account for the infrequent occurrences in recent years.—HOWARD S. HUENECKE, *U. S. Fish and Wildlife Service, Des Lacs National Wildlife Refuge, Kenmare, North Dakota.*

Foraging Activities of the Snowy Owl (*Nyctea scandiaca*) During a Period of Low Lemming Population.—Following the "crash" in the population of the brown lemming (*Lemmus trimucronatus alascensis* Merriam) during the spring of 1949, this small rodent almost disappeared from the tundra in the vicinity of Point Barrow, Alaska. Snowy Owls were fairly common throughout the summer of 1949, but much less numerous during the spring and summer of 1950. In late April, 1950, a Snowy Owl perched on a hummock of ice approximately three-fourths of a mile off shore opposite the Arctic Contractors' base camp, seven miles southwest of the geographical tip of Point Barrow. Since no lemmings were in evidence on the tundra, and would not be present out on the ocean ice, there was speculation about the source of food for the large owl.

Eider ducks had begun to drift northward in fair-sized flocks, and Eskimo hunters killed a few each day while waiting for whales to appear along open leads off shore. Since the Eskimo usually fires into a *flock* of ducks rather than at an individual bird, the number of wounded ducks not recovered by the hunters is disproportionately high. Casual observation of the owl over a period of several days revealed that it was stationed almost in the center of one of the main local fly-ways of the eiders.

It seemed to pay no attention to flocks of ducks passing overhead. One day the owl was seen to fly erratically about a comparatively restricted area, making frequent swoops at something on the uneven surface of the sea ice. Examination of the area several hours later indicated that the Snowy Owl had either killed an injured female King Eider (*Somateria spectabilis*) or had harried it until it died from the combined effects of gunshot wounds and exertion. The owl had stripped most of the flesh from the carcass.

About a month after the above episode, and before the owl working over the ocean ice had moved inland, another Snowy Owl began a systematic patrol along a single-wire antenna that ran inland about a mile from one of the radio stations. A series of poles supported the wire about fifteen feet off the ground. Red Phalaropes (*Phalaropus fulicarius*) frequently flew from one small lake to another and in so doing often flew across the antenna. One or more of the phalaropes struck the tautly stretched wire daily, and a large percentage of these was killed or seriously injured. The owl slowly flew up and down the antenna, stopped at every pole for a short period, then proceeded to the next. The owl quickly devoured any phalarope injured badly enough to seriously impair its flight. I never saw the owl attempt to capture an uninjured phalarope.

During the spring and summer of 1952, when lemmings were numerous, I again saw Snowy Owls flying leisurely along the antenna, presumably to pick up crippled birds, but none was observed hunting injured ducks on the sea ice off shore.—IRA L. WIGGINS, *Arctic Research Laboratory, Point Barrow, Alaska.*

Analysis of the Call of the Whip-poor-will.—Tall (Audio Engin., 34 [Aug.]: 1950) has stated that "The human ear, when it is behaving normally, can understand, or perceive, an unrelated sound following another sound after a period of time approximately 0.14 seconds long." In examining a number of bird calls with an oscilloscope, very short pulses of sound with intervals less than this were observed. When bird calls contain pulses of a given frequency with short intervals between them, the impression gained is that of a metallic clatter or rasping sound. Some birds produce very rapid frequency modulation of a continuous call or signal with very rapid amplitude modulation. This gives the impression to the normal ear of separate notes, the intervals being low amplitude portions of the call.

Recently the authors examined a fine tape recording of the call of the Whip-poor-will (*Caprimulgus vociferus vociferus*) made by Mr. and Mrs. Jerry E. Stillwell during May and June, 1950, in Kentucky. These recordings were made on Minnesota Mining & Manufacturing tape no. 100. Some were at 15 inches per second and some at 7.5 inches per second. No appreciable difference between these was detected. When this recording is projected on an oscilloscope there are revealed pulses of sound, and modulation of both the frequency and amplitude which the ear did not approach interpreting with any degree of accuracy. The oscilloscope trace with its brief residual period permitted the eye to sense what the ear was incapable of. However, when the playback speeds are changed to one-half, one-fourth, or one-eighth of the original, an aural interpretation is gained which confirms the optical impression produced by the oscilloscope. There are three separate parts to the call. Generally only the third of these is audible as the *whip-poor-will*, though occasionally when one is close to the bird the second part is heard as a *chuck* preceding the third longer portion. The first note, visible on the oscilloscope and audible when the recording is played back at the slower speeds, is not normally heard because its amplitude is quite low, and its period of duration is so short that the ear does not detect its presence. According to Miller (Journ. Acoustical Soc. Amer., 20: 160–161): "When a

stimulus is presented the response is not immediate, but builds up over a period of time . . . . a brief stimulus must be more intense in order to appear equal to a longer stimulus."

The duration of these three pulses of sound and the intervals between them were studied. The first pulse is about 0.011 seconds long. During this time the frequency rises about two notes of an octave and drops about one note. After an interval of about 0.047 seconds, there is the second pulse of sound of about 0.092 seconds duration. This is modulated in two steps wherein the sound rises about two notes, drops one, and then rises about one note. After an interval of about 0.14 seconds, the third and final element of the bird's call is given. This begins at about a note lower than the previous, and is frequently modulated up the scale to about the sixth or seventh step, then drops off about three notes. This is approximately 0.67 seconds long. The time interval between calls is approximately 0.34 seconds.

It is difficult to interpret the aural response to the Whip-poor-will call. The word "whip-poor-will" spoken into an oscilloscope shows not even a remote resemblance to the trace produced by the bird's call. Cleaves (Auk, 62: 304–305, 1945) states that the Whip-poor-will says *purple-rib*. In general, the amplitude modulation coupled with the frequency modulation, and together with the preliminary pulses of sound over short intervals, establishes the characteristic of the call of this bird. Obviously the ear does not comprehend all of its elements, but gains an impression which is an ear-limited composite. The variation in the amplitude plays an important rôle in the psycho-acoustic affect on the human listener. The first note is of very short duration and is of an amplitude about a fifth of the greatest amplitude in the call. The greater portion of the second note has an amplitude which approaches the maximum for the whole call. The third portion of the call starts at an amplitude lower than the major part of the second note, increases rapidly toward the end, and then drops off rapidly. There are approximately 59 calls per minute, sometimes repeated for 15$_{+}$ minutes or longer. Cleaves reports hearing the bird call continuously for more than 1000 calls.

There appears to be the impression among numerous individuals who have had some musical training that the sounds of nature, and particularly of birds and insects, have numerous harmonics. Except for a few birds such as geese, ducks, and quail, the "tones" produced are usually free from harmonics at least in the audible range. Mrs. Wing (Auk, 68: 189–193, 1951) in her fine work on the variations in the song of the Hermit Thrush indicates the presence of harmonics. It is possible that this bird does sing a fundamental with one or more audible harmonics; it is more likely that two or more short pulses of notes in sequence separated by short intervals are interpreted as being simultaneous and therefore harmonic. In a recording of the Eastern Hermit Thrush by Jerry Stillwell no harmonics were visible on the oscilloscope. The calls of the majority of our song birds produce typical sine waves which, however, are frequency modulated, and on the oscilloscope they show considerable amplitude modulation which makes partial envelopes of sound.

This study was carried out with aid from the University of Utah Research Fund.—STANLEY MULAIK, WILLIS LEE, AND JERRY E. STILLWELL, *Division of Biology, University of Utah, Salt Lake City, Utah.*

The Nest of the Long-billed Gnatwren (*Ramphocaenus rufiventris*).—The affinities of the neotropical genus *Ramphoccenus* have been in doubt. Formerly regarded as belonging to the sub-oscine antbird family, Formicariidae (Ridgway, U. S. Natl. Mus. Bull., 50 [5]: 14, 1911), this genus is now considered to be truly oscine and is allocated to the same subfamily as the gnatcatchers (*Polioptila*) (Wetmore,

Proc. U. S. Natl. Mus., 93: 306, 1943; Mayr, Auk, 63: 67, 1946). While differing strikingly in voice, brown color pattern, and long bill, *Ramphocaenus* does resemble *Polioptila* in being a thicket dweller, in its slender build, and in the nervous twitching of its tail, which usually is carried erect. Though *Ramphocaenus* ranges from tropical Mexico southward, no description of the nest of any form of the genus has apparently been published. On July 15, 1950, I found a nest of *R. rufiventris* in the Juan Franco suburb of the city of Panama, Panama. This area consists chiefly of open country, but the nest was in a damp thicket, about 15 feet from a narrow stream used as a drainage ditch, which was well shaded by a growth of fair sized trees. The nest was an open cup built among the vertical shoots of a small shrub, about six inches off the ground. It was composed chiefly of grass-stems, with a few twigs and dried leaves, and to the exterior were attached several large dried leaves that hung loosely along the sides and extended below the nest proper, forming a sort of ornamental skirt. Measurements: exterior diameter, 4 inches; interior diameter, 3 inches; exterior depth, 5 inches; interior depth, 3 inches. The nest contained two almost naked young, apparently a few days old. It was discovered by watching an adult carrying an insect to the nest.

Dr. Alexander F. Skutch writes me that he found a somewhat similar nest in Costa Rica in 1939; the two eggs were laid on April 14 and 15. Skutch also reported that the incubation period was 17 days, the nestling period, 12 days (Auk, 62: 21, 1945). Dr. Skutch also tells me that when hatched, the young are completely devoid of down, and that both parents incubate and care for the nestlings.—EUGENE EISENMANN, *11 Broadway, New York 4, New York.*

Notes on the Yellow Warbler in Surinam.—The Yellow Warbler (*Dendroica petechia*) is a common winter visitor in Surinam. According to Zimmer (Amer. Mus. Novit. No. 1428, 1949: 5), only the race *aestiva* has been taken there, but the race *brewsteri* probably also occurs there since it has been found in both British and French Guianas. The earliest known arrival date, August 28, 1921, was recorded by the late Thomas E. Penard (Auk, 44, 1927: 425). The Penard brothers earlier (De Vogels van Guayana, Vol. II, 1910: 483) gave a series of six arrival dates (September 10, 6, 7, 17, 16, and 3) but did not mention the respective years. I have been unable to find any published information on the date of departure for the breeding grounds. My records of the dates of arrival and departure are as follows:

Season	*First Seen*	*Last Seen*
1945–1946	—	March 17
1946–1947	September 17	March 29
1947–1948	September 22	April 8
1948–1949	September 1	March 25
1949–1950	September 6	April 10
1950–1951	September 4	March 28
1951–1952	September 3	April 5
1952–1953	September 8	April 13

In Surinam, the Yellow Warbler is one of the most striking of the northern migrants and is found in trees and shrubbery in the smallest gardens and back yards of Paramaribo. I do not agree with Penard that it is a shy bird, and it certainly does not confine itself to the tree tops. When foraging, Yellow Warblers frequently utter their call note, a characteristic "chip," by which their presence is first noticed each year. Having never been in the breeding haunts of this species, I do not know its song,

but a few times (November 21 and 27, 1949, and March 4, 1950), I heard a rhythmical four-syllabled "chee, chee, chee, chee," call which was repeated again and again.

This species seems fond of bathing, and I have observed two different types of this behavior. During a heavy rainstorm, a warbler will frequently perch in an exposed place and, with spread tail and trembling wings, will let the rain go all over its body. This behavior is alternated with periods of preening. The Yellow Warbler also takes what I call "rubbing baths," a habit characteristic of several kinds of hummingbirds. For instance, after a heavy shower on November 8, 1948, I saw a Yellow Warbler fluttering over the drenched leaf of a frangipani (*Plumiera rubra*) and rubbing the ruffed-out feathers of its belly over the leaf.—F. HAVERSCHMIDT, *P. O. Box 644, Paramaribo, Surinam.*

Recent Increase of the English Sparrow (*Passer domesticus*) in State of Veracruz, Mexico.—In the course of almost daily field work in the central and southern parts of Veracruz, carried on over a period of more than five months in 1937 and 1939, I was unable to find a single English Sparrow. In fact, the first published record for the state seems to be that of Lowery and Dalquest (Univ. Kans. Publ., Mus. Nat. Hist., 3: 631, 1951), who write: "abundant about human habitations in central Veracruz."

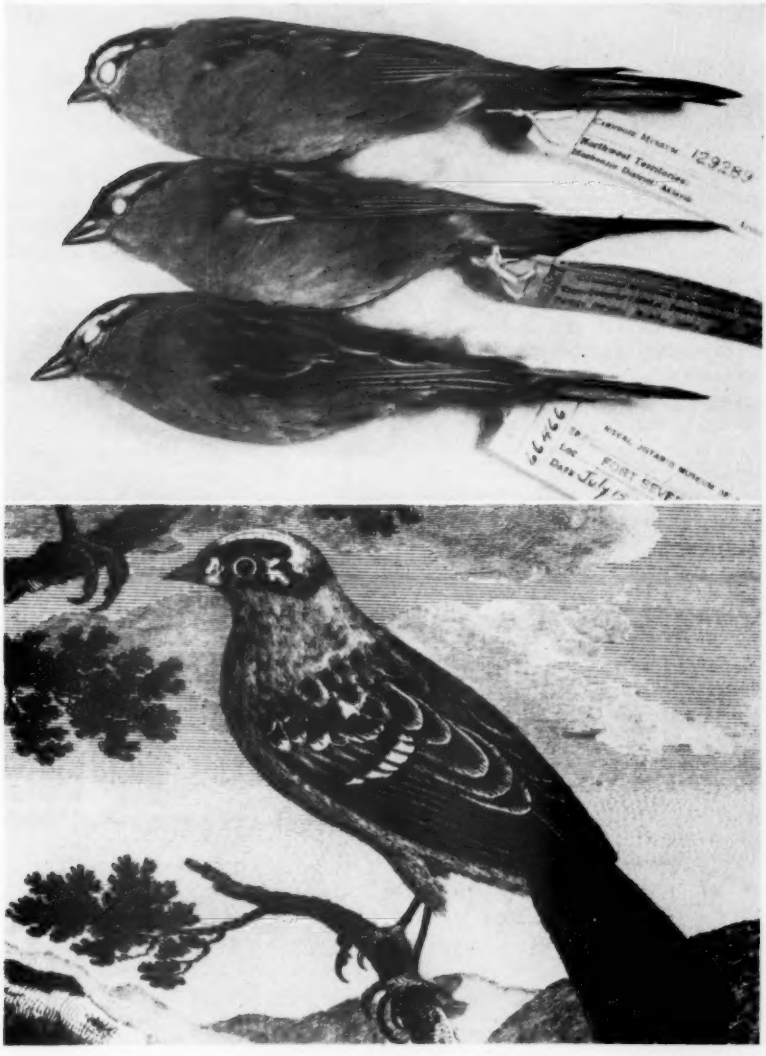
Returning to Veracruz in the summer of 1952, I was, therefore, not surprised to find these birds now common in almost every town visited in the central part of the state, including many of the same places where I had seen none thirteen years before. They are now about equally plentiful from sea-level at the city of Veracruz up to an elevation of 8000 feet at Las Vigas, and south at least as far as Tlacotalpam, where none was seen by Wetmore and Carriker in 1939 and 1940 (Wetmore, Proc. U. S. Natl. Mus., 93, 1943). Moreover, they are now well distributed in most or all of the settled areas throughout northern Veracruz, from Pueblo Viejo and Empalmé Tamós, near Tampico, south through Poza Rica, Papantla, and Gutiérrez Zamora to Martínez de la Torre and Tlapacoyan.

This recent dispersal may be due in part to the new highways linking northern and central Veracruz with Tampico, where they are numerous, for on two occasions I noted a few English Sparrow stowaways on trucks passing through unpopulated districts on their way from Tampico to Poza Rica. One isolated pair was seen at a culvert in a pine forest on the highway about 15 kilometers north of Perote, the nearest town of any size.

That this sparrow is now also invading other areas in Mexico has recently been recorded by M. A. del Toro (Condor, 52: 166, 1950), reporting the sudden appearance of small numbers at Tuxtla Gutiérrez, Chiapas.—FREDERICK W. LOETSCHER, JR., *Centre College, Danville, Kentucky.*

Further Taxonomic Notes on the White-crowned Sparrow.—Let me say at the outset that I favor every effort being made to avoid disturbing changes in names of familiar species. I was most reluctant to propose such a change in the genus *Zonotrichia*, as is shown by my written notes made some years ago, before I saw Hope's Fort Severn specimens. At that time, I suggested that the only way I could see to save *leucophrys* of Forster for the White-crowned Sparrow was to restrict the type-locality to Fort Albany. Since then the A.O.U. Committee has designated Fort Severn instead, and a series of specimens from that place is now available.

But now it is argued that, since birds of both the white- and black-browed types occur at Fort Severn (although apparently not in equal numbers), Forster's name *leucophrys* could apply to either one. Since the name is therefore indeterminable on



Todd: Further Taxonomic Notes on the White-crowned Sparrow. (*Above from top to bottom*) *Zonotrichia leucophrys leucophrys* from Aklavik, Mackenzie (Carnegie Museum No. 129289), adult male, May 12, 1942; *Zonotrichia leucophrys nigrilora* Todd, type from Point Natashquan, Quebec (Carnegie Museum No. 102527), adult male, June 1, 1928; *Zonotrichia leucophrys leucophrys* topotype, from Fort Severn, Manitoba (Royal Ontario Museum of Zoology No. 66466), adult male, July 15, 1940. (*Below*) White-crowned Bunting—*Emberiza leucophrys* Forster. Figure from Pennant's Arctic Zoology, 1785, pl. xvi. Slightly enlarged from original. All from photographs by Arthur C. Twomey (lower figure from negative supplied by Museum of Comparative Zoology).

the basis of the original description, its application must be determined from the "first reviser." On this principle Pennant was unwittingly the "first reviser," although he merely copied Forster's account and added a few words of his own, with a figure. I cannot agree that this figure clearly represents the black-browed eastern bird. To my eye it looks more like the white-browed form, and if, as is possible, it was based on Forster's type-specimens, it tends to strengthen the conclusion I have already reached.

But more is involved in this case than the standing of the proposed new name. It opens up the whole question of the status and relationship of the several forms of this group. Certain authors have commented on these matters, notably Swenk (Wilson Bull., 42:81, 1930). This writer was inclined to believe that *leucophrys* and *gambeli* are distinct although closely allied species, and not merely subspecies, as they are generally considered. Else how can both forms be found breeding at the same place? (Swenk's paper, be it noted, appeared before much collecting had been done on the west coast of Hudson Bay.) The late A. J. van Rossem, in transmitting a note on the type of Bonaparte's *Spizella maxima*, expressed himself to the same effect. If two species are involved, their respective breeding ranges must overlap throughout a considerable area. But wherever we find both forms together, one or the other is always in the ascendancy, and apparent intermediates between the two exist.

After a further intensive study of our series (346 specimens) I suggest that the white-browed and black-browed types may be only color-phases or mutants of one single species. Where either type is localized it may be considered as a subspecies, but where the two occur together regularly, as on the west coast of Hudson Bay and west into Alberta (*fide* Riley), they had better be regarded, taxonomically, as constituting only one form. Certainly the black-browed and the white-browed individuals from Fort Severn and Churchill are indistinguishable from each other by any other mark; indeed they appear to constitute an otherwise homogeneous population, which, however, is readily separable from that of the Labrador Peninsula. As yet we do not actually know that these respective types breed together (*cf.* Taverner and Sutton, Ann. Carnegie Museum, 23: 78, 1934), but the inference is strong that they do. I am unable to separate satisfactorily the west coast (Hudson Bay) white-browed birds from a series of breeding specimens of *gambeli* from the Mackenzie Delta. Consequently, I still think that *gambeli* of Nuttall (based on a transient) must be regarded as a synonym of *leucophrys* Forster (west coast of Hudson Bay).

Be it noted that Hudson and James bays bisect the otherwise transcontinental breeding range of *Zonotrichia leucophrys* into two portions. The population of the Labrador Peninsula is completely cut off from that of western Canada. (The Tree Sparrow [*Spizella arborea*] has a similarly discontinuous summer range.) It comes as no surprise, therefore, to find that this geographical segregation corresponds to certain racial distinctions. Taken in series, seasonally comparable specimens from the Labrador Peninsula are paler, less grayish, above than birds from Fort Severn and Churchill (taken collectively, without regard to loral coloration); the brown streaking is stronger, better defined; the underparts are obviously paler, less suffused with grayish; and the bill (in the skin) is more deeply colored (this probably accentuated in life). The differences are as well marked as in the case of the Warner Mountain bird (*oriantha* Oberholser). If the one form is worthy of recognition, so is the other. Independently of the identity of Forster's *leucophrys*, the bird of the Labrador Peninsula is separable on its intrinsic characters. I find that in our series of specimens from the east coast of Hudson and James bays there are several white-browed in-

dividuals (from the offshore islands as well as the mainland), but according to my views these have no more significance than do the black-browed examples from the west coast of the Bay. Taverner and Sutton record a white-browed bird from the north shore of the Gulf of St. Lawrence. Moreover, fall- and winter-taken adult birds show the same characters. These considerations will account for the sporadic occurrences of white-browed birds which have been reported from the East, and also (so I believe) for the records in migration of such birds in Michigan (Van Tyne, Wilson Bull., 42: 95, 1930).—W. E. Clyde Todd, *Carnegie Museum, Pittsburgh, Pennsylvania.*

The Application of the Name *Emberiza leucophrys* Forster.—*Emberiza leucophrys*, proposed in 1772 by Forster (Phil. Trans., vol. 62, 1772, p. 426), has been accepted as the subspecific name for the eastern race of the White-crowned Sparrow without question until recently, when W. E. Clyde Todd (Proc. Biol. Soc. Washington, vol. 61, March 4, 1948, pp. 19–20) considered that it must be applied to Gambel's White-crowned Sparrow, currently known as *Zonotrichia leucophrys gambelii* (Nuttall). On this basis he proposed the name *Zonotrichia leucophrys nigrilora* for the eastern white-crown. Mr. Todd reviewed this matter before the meeting of the A. O. U. in Montreal in 1951, and later submitted the series of fine specimens on which he based his conclusions to the writer, as Chairman of the Committee on Classification and Nomenclature of the American Ornithologists' Union. The present note is a summary of a detailed study of this interesting problem.

Forster on pages 403–404 of the reference cited above lists his new name in connection with two specimens from Severn River and Albany Fort and gives some account in English of habits and occurrence. The technical description in Latin that follows on page 426 is that of the species of the White-crowned Sparrow, but does not indicate clearly that it applies conclusively to either the eastern race or to Gambel's White-crowned Sparrow.

The 14 specimens at hand from Mr. Todd are all from Fort Severn, none being seen from Fort Albany. In this series 9 are *gambelii*, 2 *leucophrys*, and 3 appear intermediate (the names being taken in the currently accepted sense). Both forms under discussion therefore are represented at Fort Severn. The two original birds listed by Forster have disappeared so far as known so that no specimen that may be taken as Forster's type is available.

It appears to the writer that Forster's name *Emberiza leucophrys* as set up in 1772 is to be considered a composite, covering both races of the bird that are under consideration, since it is not clearly explicit in the characters that distinguish these two, and that its formal application to one of these forms must rest with some later writer who stands in the light of a first reviser. Gmelin in 1789 and Latham in 1783 in the use of *leucophrys* clearly follow Forster, though Latham evidently had seen the work of the next author, Pennant, as he cites also "White-crowned Bunting, Arct. Zool.," but gives no page or plate reference.

Pennant (Arct. Zool., vol. 2, Birds, 1785, p. 355, pl. 16) uses *Emberiza leucophrys* Forster, and translates Forster's Latin as well as following his English. Pennant, however, may have had some further information as he gives the additional statement, not found in Forster, that "its flight short and silent; but when it perches, sings very melodiously." He also gives a plate of the "White-crowned Bunting" which depicts an adult bird with black clearly shown in front of the eye, so that it illustrates the eastern race. It thus appears that Pennant fixed the name on the eastern bird. The source of Pennant's figure is not indicated; it may have been a specimen secured by him, or possibly may have been one of the two listed by Forster.

Emberiza leucophrys next appears in Wilson (Amer. Orn., vol. 4, 1811, p. 49, pl. 31, fig. 4) where it is clearly the eastern subspecies, the plate being taken from a bird "shot in the Great Pine swamp, in the month of May." Usage in subsequent writings was fixed clearly on the eastern race of the bird, and has there remained. The check-list committee after a full discussion has accepted Forster's name *leucophrys* as applying to the eastern subspecies.—ALEXANDER WETMORE, *Smithsonian Institution, Washington, D. C.*

Fishing by the Common Crow (*Corvus brachyrhynchos*).—Thousands of Common Crows were present on the Wheeler National Wildlife Refuge during the winter of 1950–51. This refuge is located in the Tennessee valley of northern Alabama, and includes a part of the backwaters of Wheeler reservoir, one of the multiple purpose impoundments of the Tennessee Valley Authority. The winter was severe, with backwaters alternately freezing and thawing. Food in upland fields became scarce about January 1.

Crows were noted fishing on and near the refuge in company with Ring-billed Gulls (*Larus delawarensis*) and Herring Gulls (*Larus argentatus*). On January 1, the senior author watched these birds taking live fish. The fish were usually small shad or toothed herrings, two to three inches long, and were present in large schools near the surface. Excessive cold may have made them comparatively inactive. Crows would fish by hovering a few feet above these schools, dropping to the surface, and submerging their feet deep enough to seize the fish. Wings or bodies were not allowed to touch the water. The crows appeared to average a catch for each three attempts of this type. Reluctance to come in contact with the water made fishing by the Crows far less successful than by the gulls.

This fishing was common throughout the remainder of January, and the month of February. Observation at close range, with binoculars, left no doubt that crows were actually taking live fish, since these could be observed wriggling in the birds' claws as they flew to the shore to feet on these catches.—DAVID C. HULSE AND THOMAS Z. ATKESON, *P. O. Box 1643, Decatur, Alabama.*

Wing Claws in the White-necked Crow (*Corvus leucognaphalus*).—While preparing the skeletons of five White-necked Crows, kindly collected for me by Mr. W. H. Bussey near Mirebelais, Haiti, I noted the presence of a well developed ungual phalanx on each pollex of an adult female specimen. Mr. Bussey had "roughed-out" and dried the specimen in the field. The horny sheaths of the claws were lacking; only the osseous cores remained. That of the right side measured 6.2 mm. in length, the left one, 3.2 mm. Each showed definite curvature, being concave in palmar aspect.

The occurrence of vestigial claws on the wings of birds has been summarized by Fisher (Amer. Midl. Nat., 23: 234–243, 1940). As far as I am aware, the occurrence of wing claws in the family Corvidae has not been previously reported. In fact, records for the entire order Passeriformes are rare. Mention should be made of Friedmann's paper (Auk, 69: 200, 1952), in which he reported claws on the wings of the Kiskadee Flycatcher (*Pitangus sulphuratus caucensis.*)—JULIAN J. BAUMEL, *Biology Dept., University of Florida, Gainesville, Florida.*

NOTES AND NEWS

The 11th International Ornithological Congress, Sir Landsborough Thomson presiding, will be held in Basel (Switzerland) from May 29 to June 5, 1954.

During the week of the Congress, 5 days will be devoted to meetings and 2 to excursions. Before and after the Congress (May 25 to 28 and June 7 to 19) excursions will be arranged to enable members to become acquainted with the Swiss avifauna, especially of the Alps and Lower Alps. The Congress fee is 30 Swiss francs ($7.00 at the curent rate of exchange).

The prospectus, containing registration form and detailed information, will be distributed this summer. Applications to attend, and to contribute scientific papers, should be sent in before February 28, 1954, and addressed to: XI International Ornithological Congress, Zoological Garden, Basel, Switzerland. Inquiries concerning the Congress may also be sent to this address.

Dr. Ernst Mayr, Curator of the Whitney-Rothschild Collection, American Museum of Natural History, has been appointed Alexander Agassiz Professor of Zoology in the Museum of Comparative Zoology, Harvard University. Mr. James C. Greenway, Jr., has been appointed Curator of Birds in the Museum, succeeding the late James L. Peters, and Mr. Raymond A. Paynter, Jr., has been appointed Assistant Curator of Birds.

Dr. Charles G. Sibley has accepted an appointment to teach ornithology at Cornell University. He will succeed Dr. Arthur A. Allen, who is retiring.

Although not listed on the program for the Seventieth Stated Meeting, Mr. James B. Dixon of Escondido, California, participated in the panel discussion on the comparative biology of the genus *Empidonax*. He spoke on the nests and habits of western species of the genus and illustrated his remarks with excellent slides taken in California.

Membership of Committees for 1953:

Committee on Endowment: Betty Carnes (Mrs. Herbert E.), *Chairman*. Eugene Eisenmann, Ira N. Gabrielson, Douglas S. Miller, A. W. Schorger.

Treasurer's Report, Fiscal Year Ending September 30, 1952

Income to Active Fund Account

Dues		
Fellows	$ 274.75	
Members	702.05	
Associates	9,778.29	
		$10,755.09
Subscriptions		1,329.62
Sale of back issues of "The Auk"		470.89
From authors for reprints		256.36
Miscellaneous sales past year and Canadian accumulation		247.78
Advertising		389.00
Donations to Active Publications Fund		984.00
(This includes $650.00 from E. D. Palmer Memorial Fund)		

Income from	
General Endowment Fund	$ 1,504.01
Ruthven Deane Fund	342.95
Educational Fund (dues for 25 Student Members)	100.00
	$16,379.70
Less returned checks	28.25
Total Income—1952	$16,351.45

SPECIAL FUNDS

Brewster Memorial Fund		
Balance of 1951 income	$ 18.47	
Income from investments	554.95	
Cost of 1951 medal and postage		18.79
Honorarium to Dr. Kendeigh		536.16
Balance in Checking Account		18.47
	$ 573.42	$ 573.42
Educational Endowment Fund		
Balance of 1951 income	6.65	
Income (1952)	102.32	
Committee Expenses		4.69
To Active Account, 25 Student Members		100.00
Balance in Account		4.28
	$ 108.97	$ 108.97
Bird Protection Endowment Fund		
Balance of 1951 income	$ 55.59	
Income (1952)	70.42	
Donations to the Fund	30.45	
International Union for the Protection of Nature, 1951 and 1952 Dues		20.00
International Committee for Bird Protection, 1951 and 1952 Dues		10.00
Natural Resources Council		15.00
Letters and Printing		47.66
Balance in Account		63.80
	$ 156.46	$ 156.46
Endowment Fund		
Previously collected, to be invested	$ 404.25	
8 Life Members 1952	800.00	
7 Partial Payments of $25.00 each	175.00	
Donations to the Fund	270.00	
From Canadian Account	1,558.30	
Additional payment of one Patron	900.00	

To Investing Trustees		$ 4,100.00
Balance in Account		7.55
	$ 4,107.55	$ 4,107.55

DISBURSEMENTS

Manufacturing and distribution of "The Auk"		$10,540.92
Reprints from "The Auk" for A. O. U.		23.98
Editor's Expenses		500.00
Secretary's Expenses		500.00
Treasurer's Expenses		487.12
Associate Certificates		40.60
Expense 1951 meeting, paid after meeting		194.14
Expense 1952 meeting, paid before meeting		267.45
Letter to members about Zoological Record		42.75
Postage to Zoological Society of London		4.81
Letter Service, Plates, Changes and Filing		351.39
Stationery, all offices		263.17
Purchase and express on back issues of "The Auk"		50.33
Mailing back issues of "The Auk" from Omaha and Lancaster		142.58
Mimeographed Price-list of back issues		14.87
Telephone and telegraph		24.29
Bank charges and refunds		44.81
All 1952 dues notices		202.12
Donation to Zoological Society of London for 1951 and 1952		50.00
Endowment Committee Expense		130.46
Research Committee Expense		22.95
Membership Committee Expense		216.51
TOTAL EXPENDED 1952		$14,115.25
Total Income 1952	$16,351.45	
Expended over Income 1951	348.14	
	$16,003.31	
Total Expended—1952	$14,115.25	
In Active Account, September 30, 1952	$ 688.06	
Amount in Active Account		$ 688.06
Balance of Endowment Fund income	$ 7.55	
Balance of Educational Fund income	4.28	
Balance of Bird Protection Fund income	63.80	
Balance of Brewster Fund income	18.47	
Balance in Aves Section	3.00	97.10
Bank Balance September 30, 1952		$ 785.16
Special Publications Fund (including $1,200 from Active Account according to action of Finance Committee)		$ 6,212.58

R. ALLYN MOSER, *Treasurer.*

RECENT LITERATURE

Parental Care and Its Evolution in Birds.—S. CHARLES KENDEIGH. Illinois Ecol. Monogr., 22: v + 356 pp. Cloth, $5.00; paper, $4.00.

Among the greatest needs of ornithologists today are scholarly studies that bring together, correlate, and synthesize the widely scattered literature on some topic such as parental care in birds, and this Dr. Kendeigh has done in his new book.

In the first section of "Parental Care and Its Evolution in Birds," Dr. Kendeigh describes the ingenious electrical devices (developed by the workers at the Baldwin Research Laboratory and by others on both sides of the Atlantic) for use in nest studies. The section includes seventy-eight pages which record the results of an intensive study of the House Wren (*Troglodytes aëdon*) made at the Baldwin Laboratory. There are also shorter reports on 19 other American birds of widely differing families which Kendeigh studied for comparison. These studies, though brief, are extremely important contributions. It is unfortunate that, for most of the species investigated, Kendeigh has failed to mention the locality of the study. Locality is, of course, of real importance in interpreting such data.

The second major section of the book is devoted to a survey of the published data on families of "the birds of the world" and to thoughtful discussion of the evolution of parental care in birds. Dr. Kendeigh generously acknowledges the work of several assistants who helped over the years on the task of compilation. It is regrettable that their work seems not to have been adequately checked and coordinated. Thus we find *Grallina*, *Hemipus*, and *Colluricincla* included in the Prionopidae, a classification hardly used elsewhere since Mayr's analysis of the family in 1943. The Honeyeater family is called Meliphagidae (p. 265) and also Melithreptidae (p. 287). Female tinamous are said to be "more brightly colored" than males. Walkinshaw's 1947 study of *Grus antigone* is said to refer to "the sandhill crane." And Stonor's captive screamers (whose eggs in fact did not survive—Ibis, 1939:45–49) are described as producing nidifugous young.

The author states that his survey of parental care among the birds of the world includes data on all living Orders except the Coliiformes, but he makes no statement on how many bird families are treated. This is to be regretted, since the novice will certainly not suspect that 44 families of Wetmore's 1951 classification are missing. Actually, published data are available on at least the following of the 44: Numididae, Heliornithidae, Cariamidae, Steatornithidae, Podargidae, Nyctibiidae, Hemiprocnidae, Coliidae, Eurylaimidae, Phytotomidae, Pittidae, Campephagidae, Dicruridae, Cracticidae, Pycnonotidae, Cyclarhidae, Nectariniidae, and Drepaniidae.

The value of the book is seriously reduced by a lack of attention to what some people refer to as the "minutiae." The publisher has apparently made little effort to edit the "details" of English or to eliminate the errors made by the typesetter; the author seems to have overlooked entirely the need for checking the scientific names. Errors will creep in despite our best efforts, but when the errors in the scientific names in the index approach 5 per cent of the total, any reviewer is entitled to protest, and the more skeptical users of the volume may wonder whether a similar proportion of less easily detectable errors occurs among the thousands of figures listed in the book's 52 tables.—J. VAN TYNE.

The Fulmar.—JAMES FISHER. London: Collins. xv + 496 pp., 1 painting (frontis.), 82 phot. (4 in color), 70 maps, diagrams, and line drawings. 1952. 35 shillings. This New Naturalist *Monograph* is a notable contribution to avian literature; it adds to and expands in narrative style Fisher's paper on Fulmar population

problems (*Ibis*, 94: 334–354, 1952) and draws on his bibliography of 2,378 items. These titles mostly are omitted from this volume, which is aimed at the general reader; the bibliography has been deposited with the Society for the Bibliography of Natural History, c/o British Museum (Natural History), London, and, let us hope, eventually it may be published. The present book is, in a large measure, the product of a successful cooperative enterprise—the British Trust for Ornithology's Fulmar Investigation. Knowledge of his subject has enabled Fisher to piece together an account of much wider scope than was covered by the Trust's investigation and to evaluate statements about the Fulmar that are scattered through many accounts of voyages and explorations.

Following K. H. Voous (1949), Fisher (p. 8) states that it is "abundantly clear" that the Fulmars of both hemispheres belong in a "superspecies" comprised of: *Fulmarus glacialoides* (A. Smith) of the Antarctic and sub-Antarctic, which has occurred north of the Equator in the Pacific; *F. glacialis rodgersii* (Cassin) of the North Pacific; and *F. g. glacialis* (Linn.) of the North Atlantic. Not all ornithologists will agree with this treatment. Validity of the proposed race *F. g. minor* Kjaerbølling of Baffin Island, northwestern Greenland, and vicinity is questioned. Differences between the three recognized forms of the superspecies are those of degree, notably in bill shape. Voous theorized that Fulmars spread from the Southern Hemisphere to the North Pacific, then through the Arctic Ocean to the North Atlantic. All three birds are polymorphic—containing light, all degrees of intermediates, and dark individuals. The Antarctic bird is treated very briefly. About 20 pages are devoted to the Pacific Fulmar, whose range and breeding stations are poorly known; generally speaking, the percentage of dark-phase birds decreases with high latitude, the situation being the opposite in the Atlantic Fulmar.

Distribution and the breeding stations of the Atlantic Fulmar are documented in great detail and mapped for each two-month period of the year. The picture is one of dispersal, not migration, and the shifting pattern is related mainly to food availability and the time the birds have to find and gather it. Nowhere in its range has this bird occupied all of the sites that appear to be suitable breeding stations. There is strong support for the theory that the spread of the Fulmar in the past two centuries was caused by a change in food and its supply, this being first the waste of whales and, following the decline of whaling, fish offal from trawlers. In Britain and vicinity, the spread in recent decades has been tallied to the extent of noting when and for how many years Fulmars 'prospected' sites before nesting at them. The birds even have 'prospected' the cliff-like walls of castles. In parts of its range the Fulmar breeds inland, some distance from the sea.

The annual cycle in sizable British and nearby colonies is as follows: birds begin arriving about the end of October (up to months later at smaller colonies and 'prospecting' places); the population increases, but fluctuates, into January; it decreases in February–March; there is a peak in April; after a sharp drop in May there is another peak and breeding begins. Courtship evidently consists of relatively few formalized actions (much more data are needed). The egg is incubated alternately by both adults, with change-over at intervals of 2–5 days, for about 53 (range of 41–57) days. Fledging requires about 46 (41–57) days; near the end of the fledging period the chick, which is tended by both parents, may outweigh an average adult. They desert it and, some time thereafter, it flies to the sea. The annual cycle begins later, but may not end later, in the Arctic. Perhaps 7–9 years pass before the Fulmar first breeds. It is postulated that, contrary to the theory of Wynne-Edwards (1939), most adult Fulmars breed yearly.

'Psittacosis' (ornithosis) may have been contracted by Fulmars eating infected dead parrots thrown overboard. It was detected among humans in the Faeroes beginning in 1933, in Iceland in 1939, and traced to Fulmar-fowling activities. It has become common among the birds, killing some, but evidently has not attained epizootic proportions. Because of the human illnesses and fatalities attendant upon it, Fulmar-fowling has been prohibited in the Faeroes and Iceland.

The manner of ejecting the stomach oil (really a wax) and its probable various functions are discussed in detail. As to predators, man eats more Fulmars than does any other animal. Food of the Fulmar is treated at length, also the pros and cons of possible causes of the bird's spread. Among other information included is: an Eskimo legend about the Fulmar, names and synonymy, measurements, weights of young, recovery of banded birds, statistics on Fulmar-fowling in Iceland, palatability of the Fulmar (very poor) and its egg (very good). There are indices of species and place names, but no subject index.

This book adds up to an inclusive and overall picture of the characteristics and ecology of the Atlantic Fulmar. The discussions of the relations of the Fulmar with man should interest many readers. A few pages on and diagrams of molt—a matter of some interest to shipboard observers—would have been appreciated by the serious student. The book indicates many of the existing deficiencies in our knowledge of the Fulmar and points the way for future cooperative and individual research. Major impressions gotten from reading it are (a) that it is based on an immense amount of traveling by its author and (b) that it is, for a monograph, short on precise data on breeding biology—which may be forthcoming eventually from observations on marked birds. The book's illustrations are first-rate. I caught only two minor errors in type: a wrong date for Audubon (p. 420) and omission of a cross-reference (p. 458). The world of the Fulmar and man are tied together nicely in this volume; on noting mention of "red lichens" (p. 66) I wondered whether some plant ecologist might also be tying in the plant world by a study of the development of 'ornithocoprophilous' lichens (see *Bot. Rev.*, 10: 25, 1944; *Am. Midland Nat.*, 49: 6–8, 1953) at sites that the Fulmar has occupied for known lengths of time.—RALPH S. PALMER.

A Generic Revision of Flycatchers of the Tribe Muscicapini.—Charles Vaurie. Bull. Amer. Mus. Nat. Hist., *100:* 453–538, 27 figs., 7 tables, 1953.—It is a pleasure to review this paper. There is a current trend toward synthesis; toward enlarging the scope of genera and using them to indicate relationships rather than to maximize differences. Vaurie's contribution is one of the best, if not the best, of these contributions I have seen, and in one of the most difficult groups, that of the Old World flycatchers which has nearly 400 species in it. Vaurie divides these flycatchers into four tribes: Monarchini, Rhipidurini, Muscicapini, and Pachycephalini. The first two are clearly defined; the second two intergrade with each other and with thrushes and warblers. The Muscicapini, dealt with here, includes some 113 species related to *Muscicapa* and some of the most controversial elements.

All too often it is impossible to find adequate generic diagnosis, or an author's included species. Genera that seem quite valid in one area break down completely in another. Here we have a study of specimens of all but one (of which the unique type is in Stockholm) of the 113 species. Structure, plumage and color, and habits are all considered. The result is the recognition of 12 genera that are actually diagnosed, and that without a wealth of inconsequential detail. Conflicting views are discussed, where indicated alternative treatments are pointed out, and included species listed. The reduction in number of genera is not as great as that proposed by Mayr and by Deignan recently, but some of the genera are fairly large: ***Ficedula***,

26 species; *Niltava*, 22 species; and *Muscicapa*, 21 species. The frequent new combinations are, of course, an annoyance, but many of the species went under several combinations in the recent literature anyway. All will not agree with the conclusions, but the data are presented for examination.

The total of all the characters, structure, color, pattern, and habits, are weighed together. Surprisingly perhaps, in this group, plumage and color characters seem more conservative and in general to better indicate relationships, than do structural characters. But emphasis on certain characters shifts. The immature of certain genera lack the "family character" of spotted plumage (*Culicicapa*). It is interesting to find that in a single species, *Rhinomyias gularis*, the bill varies from "typical" flycatcher-like to "typical" thrush-like. Internal characters were not investigated, and Vaurie, wisely I think, presumes that in these relatively poorly differentiated species they are not necessarily more significant than external characters. I find it irritating, and not at all convincing, to be told that a passerine bird is definitely of one group and not another because of a few anatomical characters when I know full well but few individuals of few of the species of either group have been examined, and the value and variation of the characters unknown. Habits are becoming more used in taxonomy, and as these are not "collectable," we must be dependent on description. It is interesting to find different field observers' notes diametrically opposed on relationships indicated by habits.

Earlier, Vaurie reviewed the drongos (Dicruridae), usually placed near the orioles and starlings. He called them an isolated, clear-cut family without obvious affinities. Now he suggests that certain more primitive ones show an approach to such flycatchers as *Melaenornis*. The possibility of their relation to the *Monarcha* group should not be overlooked either.

When species are shifted from genus to genus as some of these have been in recent years, nomenclatural difficulties may result. These are often ignored by authors instructed only in the "broader" aspects of the subject. But Vaurie has taken his responsibilities seriously and cleaned up as he went along. In an appendix, the allocation of names affected by the generic changes are listed.

For younger students who are attempting to "arrange" species in family groups, on the basis of a few characters seen in a few specimens, of a few species, this paper should be required reading.—A. L. Rand.

Studies on the Morphogenesis of the Brain in Birds.—Knud H. Krabbe. (Morphogenesis of the Vertebrate Brain V) (Ejnar Munksgaard, Copenhagen), pp. 1–100, 53 plates, 1952.—The Tornblad Institute for Comparative Embryology in Lund is to be complimented upon the completion of this fifth volume in the series on the vertebrate brain; the first book dealt with the structure of the reptilian brain, and the second, third, and fourth with the phylogeny of the brain in mammals.

There has been a preoccupation with domestic species of birds, or ones of some economic importance, when embryology was even considered. I believe it would be an exaggeration to say that there were, in the last half-century, as many as 25 authors who published more than passing observations on the development of the nervous system of wild birds. The domestic hen has too frequently been used for the depicting of the generalized avian brain. This is understandable for various reasons. Then too, the evidence available from the few papers published previously seems to indicate a lesser variability in ontogeny and in adult morphology in birds as compared with mammals.

All these factors make even more significant the appearance of this study of the rich collection in the Tornblad Institute. Fourteen genera in 11 orders are consid-

ered, and about two-thirds of the book are devoted to descriptions of the stages available for each species. *Spheniscus*, *Ardea*, *Cygnus*, *Phasianus*, and *Melopsittacus* receive the major attention. To a biologist familiar with chick or human development these descriptive sections may seem sparse, gross, and lacking in minute detail. It must be borne in mind, however, that this is the first information on neural morphogenesis available for many of the species treated.

The discussion of brain size and the development of its parts, in relation to body size, function, and systematic position, brings out several points of interest. Interspecific variations in size of the primordial brain are very small, as compared to variations in body size; in the second stage *Dromiceius* has a brain smaller than that of *Parus* in the same stage, and *Chlorostilbon's* brain is one-third as long as the brain of *Cygnus* when both are in the fifth stage. Slight development of the rhinencephalon in most birds is perhaps correlated with a poor sense of smell. The development of the optic apparatus seems remarkably uniform. This is perhaps just a reflection of the relative conservatism of structure which is evident throughout the organ systems of the Class Aves and especially in the central nervous system. The mesencephalon is the center of the most specialized and distinctive functions in birds. One can in all parts of the brain observe " . . . variations that may be characterized, but do not afford a foundation for any systematics" (p. 91).

There are 187 figures in the plates. These are excellently prepared and provide a wealth of comparative information on the grosser aspects of brain development.—HARVEY I. FISHER.

Vom Vogelzug. Grundriss der Vogelzugskunde.—SCHÜZ, ERNST. Verlag Dr. P. Schöps, Frankfurt/Main, 232 pages, unbound DM 18.50, bound 22.—1952.—One of the reasons why birds are watched and studied by more people than any other group of animals is the phenomenon of bird migration. The clock-like regularity of their coming in spring and departure in fall, the movement of migrating flocks, the sudden appearance of great rarities, all this has focused the attention of bird students on the problems of bird migration. Our understanding of this complex of questions has greatly advanced during the past fifty years, particularly after the introduction of the method of bird banding, and literature on the subject is accumulating very rapidly. Popular accounts of the field are common, but only few authoritative treatments of the whole field are available. The most recent is by Professor Ernst Schüz, for many years the director of the famous Vogelwarte Rossitten. The high expectations one might have of such a volume are completely fulfilled. Here is a well organized account of the whole field of bird migration, based on the entire recent literature, including that of nearly all languages, with particular emphasis on those problems which at the present are under active consideration.

The volume contains three major sections. One on methods, one on migration phenomena, and one on the causal factors. That not all birds migrate in a similar manner is still too often ignored. There are day and night migrants, there are fast and slow fliers, there are some which follow definite routes while most others fly simply in a certain direction. The case histories of the migration of 13 European species, based on banding and observation, are given in detail, in order to bring out these differences. A special section (with five maps) is devoted to the migration of tropical and southern hemisphere species. Directional and vertical migration are discussed in this section as well as the location and other problems of the winter quarters.

Almost half of the volume is devoted to two great subjects, to the physiology of migration with its relation to season and weather, and to orientation. The treat-

ment of the causes of migration is not as well organized as some other sections. The respective rôles of genetic, selective, physiological, and environmental factors in migration are not stated precisely; and the voluminous recent work on the physiology of migration, though mentioned and largely listed in the bibliography, is not discussed in detail. On the other hand, there is a very complete account on the problem of orientation with a summary of the important researches of Rüppell, Kramer, and others.

There are 55 figures, a bibliography of 11 pages, and an index. Particularly as a key to the literature on important European research on bird migration, the volume is quite indispensable. No student of bird migration can afford to be without it.—E. MAYR.

The Whooping Crane.—Robert Porter Allen. Research Report No. 3 of the National Audubon Society. xxvi + 246 pp., col. frontisp., pls. 1–13, 30 text-figs., 10 maps, 7 graphs. New York. $3.00.—A cooperative work of the United States Fish and Wildlife Service and the National Audubon Society, this work was begun in 1945 by Olin Sewall Pettingill, Jr. and taken up in 1946 by Robert P. Allen who completed it with enthusiasm and ability. This work stands as a monument to Bob Allen and others who worked for its completion.

The plates include actual photographs of captive birds and of wild Whoopers at Aransas Refuge, Texas; some beautiful life-like drawings by Bob Allen himself, which include many figures of different behavior and several outstanding dancing poses, also help adorn the book. In addition Kay G. Morton and Joel W. Hedgpeth present many figures of marine life and plants from the Aransas area where *Grus americana* spends its winter. A number of maps show past winter and breeding areas of the species in relation both to geographical and habitat ranges.

The main work is divided into eight parts: (1) Distribution, (2) Abundance, (3) Migration, (4) Food Habits, (5) Winter Life, (6) The Breeding Season, (7) Molts, Plumages, and Anatomy, and (8) Survival: Protection and Conservation. Following this are two appendices, a thirteen-page bibliography, and a seven-page index.

The serious nature of the present status of *Grus americana* is stressed throughout. But Allen produces actual observations of past ornithologists showing that this species has actually never been common during historic times. He describes fragmentary remains of seven individuals from the late Pliocene and/or early Pleistocene of California, Idaho, Kansas, and Florida showing a much wider distribution in prehistoric times.

The distribution (13 pages) from 1722, when the species was discovered, until now is described in detail. This is based on 467 actual observations, and as Allen has written (p. 50) "some old records are included on rather slim evidence." Two such records were from Michigan, both now discarded (see Josselyn Van Tyne's "Check List of the Birds of Michigan," 1938 and Norman A. Wood's "The Birds of Michigan," 1951, p. 12). However, they do include many worthwhile reports, many previously unpublished.

Allen's belief (p. 83) is that the population of this species until 1860, or possibly 1870, totalled between 1300 and 1400 individuals. Many authors, quoting authors prior to them, never saw *Grus americana* and believed it common in central North America. This was not the case, however. In 1858, Spencer F. Baird realized the inadequacy of the existing knowledge and reported it as one of the rarest of birds in collections. He knew of no specimen in any museum in the United States but during that year obtained one for the U. S. National Museum. Allen lists kill records by year and by state and province. With the large number of small museums

and private collections, it is probably impossible to get all of these, but he certainly must have obtained a large per cent.

The original wintering areas decreased in number until in 1912, 88 Whooping Cranes were estimated from six places. It is evident that ornithologists assumed that there were many more and worried little about the status of the species. Of these six places, only one remains, that at the Aransas Wildlife Refuge near Austwell, Texas. Probably if the U. S. Fish and Wildlife Service had not taken over this area and supervised it, there would be no Whooping Cranes to-day. This winter flock of cranes increased from 18 in 1938 to 31 during 1947. (Additional notes not included in this work show this increase reached a peak of 33 in 1949 and 1950, and dropped to 22 in 1952.) This presents the serious status of *Grus americana*. During a nine-year period, 1940–1949 there was an actual loss of 33 cranes, 3.6 per year, yet there was an average increase of .44 annually.

Migration periods, routes, and behavior are well described. One family group was seen in Nebraska by Allen six or seven days after they left Aransas. He presents evidence that with the disappearance of the Whooping Crane in Minnesota, Manitoba, and Iowa a similar decrease occurred in Louisiana. This is probably correct. I feel sure that Sandhill Cranes in North America east of the Rockies have and did have a similar migration route, but their range was much greater. Sandhills breeding in Michigan and Wisconsin apparently move towards and possibly through Georgia. Sandhills from the Canadian Arctic and probably Alaska proceed down through Alberta, Saskatchewan, the Dakotas, and Nebraska to Texas, New Mexico, and Mexico. In the region between these two migration routes Sandhill Cranes are now seldom, if ever, seen.

Whooping Cranes leave the Canadian Provinces between October 1 and 10, normally arriving on the Texas coast between November 2 and 8. Family groups arrive last, indicating that more time is required for the youngsters to make the trip of 1800 to 2000 miles. (Sandhill Cranes often begin to arrive in California, New Mexico, and Texas by mid or late September. During the spring migration Sandhills now begin to arrive on the Platte River in Nebraska by February increasing to greatest numbers in late March and early April. Whoopers reach this area in late March and April.)

Much valuable work was done with food. Twenty-two items were found in droppings, and 13 others were listed from observations of feeding birds. Of these items, 28 were animal and 17 vegetable. Only seven, all animal, were of major importance at Aransas, the most important being decapod crustaceans. In winter Sandhill Cranes feed mainly on grain. The Whoopers at Aransas fed on blue crabs, acorns, fishes, tubers, crayfish, razor clams, grasses, sedges, and even water scavenger beetles.

On the winter range at Aransas, the Whooping Cranes differ greatly in behavior from the Sandhill Cranes. Families of the former have definite territorial boundaries, strongly defended by some males, less so by others, yet much more than any Sandhill Cranes, or any other cranes with the possible exception of *Grus leucogeranus*. Except for some resident birds in Cuba and Florida, most Sandhills are very gregarious in winter and on migration, roosting and often feeding in large flocks. Even *Grus japonensis* in Japan and Korea often occurs in flocks in winter. Sandhills during both fall and winter feed much more on highlands, flying about sunrise from their shallow-water roosting areas to feeding areas. Apparently Whoopers do much more walking even though the Sandhills are also great walkers. At Aransas, the

management of *Grus americana* revolves around the blue crab, which is found in water with a wide variation in salinity.

Little has been published in the past on nests and nest sites of the Whooping Crane. The breeding range included three areas: one, along the coast of Louisiana; a second, whose size was and still is unknown, in the Arctic and sub-Arctic; and the third and best known, from the Prairie-Aspen Parkland Belt into the Grama-Grass Antelope Biome. Yet even in historic times, only a small part of this last area was utilized.

The last actual nesting record for the United States (except for the captive pair in Texas) was from Iowa in 1894; the last observed nesting in Canada was in Saskatchewan (two areas) in 1922. None has been found since. Neither Pettingill, Fred Bard, Bob Smith, Allen nor any other searcher discovered any Whooping Cranes after they migrated past the farming areas of central Saskatchewan, from 1945 until the summer of 1952. (In 1952 two birds were found by Bob Smith northwest of Great Slave Lake; another possibility was the finding of tracks of a large crane with those of small young in Alberta by Rowan.)

In the past, nest sites were located in fresh-water marshes unlike the saline winter marsh but similar to those in which the Sandhill Crane nests. Thus summer food must be entirely different from winter food, as is the case with the Sandhill Crane. In summer, these marshes, sometimes as large as 3,000 acres, were shallow, overgrown with sedges, cat-tails, rushes, etc. At times Whooping and Sandhill cranes nested in the same marsh.

The behavior of the captive Whoopers at the nest in Texas showed a pattern similar to that of other cranes. Both male and female incubated, the male the more during daytime, the female more at night. Apparently this was the situation in 1949 when Bob Allen watched them for nearly two weeks. (In 1950 I watched Crip and Jo for seven complete days. On five days, the male, Crip, incubated the majority of the time while on two, Jo did the more. I arrived at the tower at daylight each morning and left after dark at night. On three mornings Jo, who was incubating when I left at dark the previous night, was still incubating. On one morning after she had been incubating at night, Crip was there at daylight; on two other occasions, it was the opposite.) Allen found similar behavior in 1949, the birds apparently changing places during the night.

Two eggs are laid, and the collecting of these eggs definitely has harmed the species. Eggs were taken again and again from Iowa marshes until both Whooping and Sandhill cranes disappeared from that state. In the existing sets of Whooping Crane eggs in museums, there are many more sets of one egg than of two. This is not the case with Sandhill Cranes or any other cranes, and I believe that collectors often divided sets of two, which probably also accounts for the fact that few data were furnished with many sets.

The plumage of the Whooping Crane was described in detail, but little is known concerning the anatomy. The colors of the soft parts were well described from live captive and wild birds.

The prospect for the future of the species is not good. Protection is necessary in areas where it occurs in winter, on migration, and in summer, and a great problem of education continues to exist. Allen has summarized this very well as he has the entire book, chapter by chapter. It is a model for similar studies and is valuable for anyone studying cranes throughout the world.

The present rate of increase of human populations could easily result in the destruction of most of the world's cranes. Civilization, with its hunters, drainage of land, obliterating of great remote areas, has advanced at a terrific rate and will probably

continue to move on even faster. Any crane is conspicuous, but a white crane is particularly so. The Whooping Crane, conspicuous because of its color, large size, and loud call and existing in such small numbers, is in an extremely dangerous spot. Only the remoteness of its present nesting area, protection on its winter range, and the birds' own wariness, together with public education, have prevented it from becoming extinct many years ago.

In comparison, during recent years Sandhill Cranes have increased on most of their range. The marshes in which they nest have decreased in numbers, and hunters shoot some of them in the fall and winter. But they are much more protectively colored than Whooping Cranes. They also were more widely spread over North America when white people settled here, and they existed in larger numbers then as well as now.

If there is any chance of saving the great Whooping Crane, Bob Allen, his many visits with people across the migration route, and his book are certainly auspicious factors for its benefit.—LAWRENCE H. WALKINSHAW.

The Birds of Crater Lake National Park.—Donald S. Farner. (University of Kansas Press), xii + 187 pp., 1 map, 16 pls. 1952. Paper-bound. $1.25.—The objectives of this book are stated in the preface to be the providing of: (1) an inventory of "the available information on the birds of the Park"; (2) basic information for a sound interpretative and informational service by Park Service personnel; (3) a park visitors' source for the "what, where, and when" related to birds of the Park (but not identification); and (4) a contribution to a better understanding of the distribution and habits of the birds of the High Cascades.

As essential background for all of these objectives the area is described briefly with respect to its location, topography, geology, and climate, and much more fully as regards its history and the progress of ornithological knowledge of it from 1855 through 1951. From this historical account it is evident that the preponderance of the information now available on the birds of the Park has come from those who have held biologist, naturalist, or interpretative positions in the Park Service in 1926 and subsequently. The author's own work in such capacity for parts of eight years since 1938 was made of considerably greater value by time allowances for research in ornithology during four of these summers.

Under "Avian Habitats" the author's general statements (pp. 10–11) about the habitat requirements of birds properly emphasize the importance of life form and spacing of the vegetation. He then describes the ecologic features important to avian occupants of eight types of coniferous forest, and of mixed forest and chaparral, chaparral, montane meadows, barren rock and rock slides, open pumice areas, streams, and "the Lake"—the depauperate avifauna of the last being accounted for by the absence of "a well-developed littoral zone, the rocky shores, and the depth of available food" (p. 6). In this description of habitats, Farner also states (p. 11) that "No implications in terms of synecology or successional ecology are intended." Yet his subdivision of the coniferous forest into eight types might well approach being a complete list of the forest associations (climax and subclimax) of the Park. The plates are photographs of good quality and reproduction, most of them depicting the appearance of these various habitats.

The life zone concept, although admittedly of less value in areas of mild relief, is applied by Farner to the Crater Lake montane area by allocating certain of the widespread forest types to the Transition, Canadian, or Hudsonian Zone, for each of which he lists certain characteristic plants and the common breeding birds. One frequent difficulty in using life zones is the necessity of explaining as "non-zonal"

the distribution of species which respond to habitat features which are other than those found in the widespread associations selected as composing any one zone or several adjacent zones. Of this, Farner says (p. 16) "the extension of the life zone concept to the biotae of such habitats as wet meadows, pumice deserts, the wet canyon floors, the talus slopes, and rock slides . . . is of questionable value."

The bulk of the book is an annotated list of 132 species known to occur within or over the Park, plus a supplemental list of 20 species for which there is some doubt as to occurrence there or "only single sight records." Several species (e.g., Eared Grebe, Wood Duck, Long-eared Owl) on the supplemental list seem as worthy of inclusion in the main list as is the Cliff Swallow which is so included (p. 75) on the basis of a single observation.

In the main list, insofar as it is known, the occurrence of each species is summarized as to relative abundance and seasonal status, and as to the life zones and habitats in which it occurs at various seasons. This is in paragraph form and is frequently followed by a documented historical summary of the growth of knowledge supporting it. By comparing these paragraphs with the discussions of habitats and zones, the interpretative naturalist and the ornithologically-interested visitor should soon learn where to find the various species of birds and what birds to expect in each of the major habitats. Much evidence of seasonal shifts in altitudinal distribution is presented for many species, and there is clarification thereby of early reports of some species as breeding birds, for which there is no verified breeding record. There are lists of observations indicating the breeding phenology of the commoner species.

Specimens collected and their present whereabouts, if known, and (for most species) sight observations as well, are tabulated in a *Resumé of Records*, except that the commoner species have only selected observations listed and the most widespread ones are treated adequately in a "summary of observations." The reviewer has been unable to find any consistent method of arrangement of records within these resumés. For most species, the arrangement seems to be by localities, but the localities are not listed in any consistent order. For some species (e.g., Sooty Grouse, Hermit and Russet-backed thrushes, Red Crossbill, Fox Sparrow) the list is chronological with locality names duplicated in the various years. With the considerable amount of valuable phenological data contained within these tabulations, such as nesting and singing dates and even data on population densities, a rearrangement of the longer lists according to calendar dates would have greatly aided anyone interested in such data for comparison with other areas. Since most of the tabulated records, with some lists numbering over 60 separate items, are for the summer seasons, the occasional non-summer record is buried in a classification seemingly emphasizing the history of ornithological effort in the region.

When the observations are referable to a given subspecies, this is indicated in the text, while subspecific identification of specimens is mentioned in either the text or the resumé, or in both. Otherwise trinomials are used only in the sub-headings for subspecies of a few species (sparrows). There is a thorough index of common and scientific names (genera, species, and subspecies).

It is unfortunate that a work such as this, which contains much information beyond that of a simple distributional list and which will find years of use by persons visiting or working in the Park, was not printed on better quality paper and with a more durable cover. The printing is good, with very few typographical errors.

Of especial interest to this reviewer and indicative of the type of information on "distribution and habits" which is scattered through the book (fulfilling its fourth objective) are such records as:

1. a Bald Eagle swimming for 200 yards.
2. a detailed record of 3½ hours observation of migrating White-fronted and Canada Geese, totalling over 3700 individuals in 58 flocks.
3. the critically trap-wise behavior of adult Steller's Jays after being once trapped. (The reviewer has had almost identical experience with this species in southern California.)
4. experiments disclosing bits of the mental capacity of Clark's Nutcrackers—the bird most conspicuous to the average visitor to Crater Lake, and appropriately figured on the cover.
5. a Dipper travelling slowly, and presumably foraging, for 30 feet along a stream beneath eight feet of snow.
6. evidence of great fluctuations in year to year numbers of Rock Wrens, Lazuli Buntings, and other species at higher altitudes.
7. first indications of the factors which may be important in enabling the significant ecologic overlap of breeding Ruby-crowned and Golden-crowned kinglets.
8. a summary of the population of Lincoln's Sparrows for 3 years on a 10-acre tract, with description of the vegetational composition of the territories and sizes of the territories during two successive years.

Such items make the book of value to those interested in various aspects of ornithology in general, as well as to those interested in a local distributional list.—HOWARD L. COGSWELL.

Arizona and Its Bird Life.—HERBERT BRANDT. (The Bird Research Foundation. Cleveland, Ohio). xvi + 1–723 + 2 pp., 62 illus., 20 being col. pls., 18 pen sketches, and 16 full page photographs. Indexed. 1951. $15.00. Although the author's experiences with birds in Arizona constitute the main theme of the book, many allied considerations are included such as physiography, climate, vegetation, life areas, other forms of animal life, history, and exploration. Not all of Arizona is covered, instead just the southeastern portion of the state is featured. A better idea of the content of the book is revealed by the subtitle which indicates that the book is an account of "A naturalist's adventures with the nesting birds on the deserts, grasslands, foothills, and mountains of southeastern Arizona."

The book is a pretentious one, selling at a relatively low price, probably at less than actual cost. It measures 10 × 7½ × 2 inches, has an attractive cover, and weighs about five pounds. The type is large, easy to read, and is printed on fine quality paper. The book is beautifully and artistically illustrated in a variety of ways. Of the 20 color plates there are nine paintings by Allan Brooks, eight by Roger Tory Peterson, two by George Miksch Sutton, and one by Terence Michael Shortt. There are 13 line drawings by Sutton and other pen sketches by Brooks and Edwin Richard Kalmbach for a total of 18. The 16 full-page photographs are by Karl H. Maslowski, Ed N. Harrison, the author, and others. An intriguing picture of the Saguaro cactus ecological formation is spread across the inside cover and front endpaper while in similar position at the back is a schematic map of southeastern Arizona showing the physiography and locations mentioned in the text.

The subject matter of the book is divided into sections. The first is rather short and serves to introduce the reader to the area. The weather is discussed. A significant contribution is the material in Chapter 3 on the distribution of birds and the ecology of the region. Five life zones and six subzones are described, and the prominent breeding birds are placed in 24 nesting associations. As categories of lesser rank the author also conceives of archipelagos, islands, and islets. A full spread, schematic, combination diagram and chart shows a cross section of the primary

physical divisions, altitudinal profile, rainfall, soil moisture conditions, life zones, dominant plants, and bird-nesting associations of the region.

Section two pertains to the deserts. This covers 215 pages and is the longest section. After discussing the nature of the desert, Brandt presents in separate chapters his experiences with certain distinctive birds such as the thrashers or groups of birds in their ecological formations. Examples of the latter are the cactus cave dwellers and birds of the cottonwood stream bottoms. An interesting chapter is concerned with a visit to old Fort Lowell, an important early-day collecting station of ornithologists.

Section three is concerned with the grasslands. Here are featured the birds in the prairie cattle country, the yucca gardens, and the Agave foothills. Another area of considerable interest in connection with early-day ornithology is Fort Huachuca, which is discussed in this section. The foothills are next treated in section four and finally the mountains in section five. Thus the author takes the reader from the streamside and desert associations of the lowlands up through successive environmental situations to the boreal habitats of the mountains. An outstanding chapter is the last one, number 50, on the wild turkey. Here much new information is presented.

The concluding section, number six, is entitled "The Appendix." It contains an annotated list of 170 nesting birds of southeastern Arizona together with a supplementary list of 23 possibly breeding birds. There are records of occurrence, however, for the latter in the region. The information presented in the appendix is based mostly on data gathered on the eight expeditions to the region conducted by the writer from 1935 to 1948. This section will be the most valuable to the student of geographic distribution of birds, although there is little systematic discussion. However, one new subspecies of the Purple Martin is described, *Progne subis oberholseri*. It seems to the reviewer that it is inappropriate to describe a new race in a book of this kind when the description could have been easily presented in a separate article in one of our ornithological journals, as the author did with the Apache Wren (*Troglodytes brunneicollis vorhiesi*) which was also discovered in the course of the field work. The emphasis throughout the book is on nesting birds, but the nesting data are concentrated in the annotated list.

Since the subject matter in the book is based primarily on the experiences and data of the author, no literature is formally cited in the text, nor is there a terminal bibliography. However, in the narrative credit is given individuals and sources of information are indicated. Opinions of Dr. Harry C. Oberholser are frequently expressed in connection with the annotated list. Indeed, in an introductory section tribute is paid to this eminent ornithologist for his encouragement, aid, and guidance.

The author's style of writing is verbose and characterized by much descriptive matter. The reader will enjoy the word pictures and intimate glimpses of southeastern Arizona. He will be intrigued with the country and all that it has to offer the bird student. Highlights of the book to the reviewer are the ecological picture of the birds of the region, the beautiful illustrations, the many exciting bird biographies, intimate glimpses of the ornithologists of the region who accompanied the author in the field, and finally the spirit of adventure and the thrill of bird finding and bird watching in southeastern Arizona with a noted naturalist.—WILLIAM H. BEHLE.

Records of Parrots Bred in Captivity.—Arthur A. Prestwich. Privately printed, Chelmsford Road, Southgate, London N. 14, England, 1–384, 1950–52, £1.15.—The active and enterprising Hon. Secretary of the Avicultural Society of London has for thirty years collected all available data on the breeding in captivity of

Parrots and Parrakeets. Many Psittacine birds are prominent among the avian species which can be propagated in confinement the most easily. Some of them, particularly the Australian Budgerigar (*Melopsittacus undulatus*) and the African Love-birds (*Agapornis*), have even become domestic birds, showing numerous color phases which are most interesting for the purpose of studies in genetics.

All the records are dealt with in detail, with many quotations, and the result is a highly informative book. The scientific names are those of Peters' Check-List of the Birds of the World.

Mr. Prestwich is to be congratulated for his painstaking, disinterested work, which proves invaluable as a source of information for all those interested in the fascinating family Psittacidae.—J. D.

Foreign Birds for Beginners.—D. H. S. Risdon. Cage Birds, Dorset House, London, 1–140, 14 plates, 10 figures in text, 1953. 1 sh. 6 p. ($1.50).—This excellent little book, which will prove most useful to all who keep birds in captivity for either pleasure or experiments, has been prefaced by the Duke of Bedford, an outstanding authority on the subject: "I have never read any treatise on this subject so full of useful information, based on personal experience, as Mr. D. H. S. Risdon's book, which should prove of the utmost value, especially to beginners in aviculture."

A bird-keeper from boyhood, the author has had extensive experience with all kinds of foreign species. Previously a Director of the Keston Foreign Bird Farm, he is now General Manager of the Dudley Zoo. He indicates in a lucid, straightforward manner, the steps a beginner should take for the care of birds. He gives a "golden rule" about the housing of exotic species, and describes briefly the various requirements, such as shelter, light, warmth, and so on. Cages, small indoor aviaries, and large outdoor enclosures are all dealt with. The feeding of the exotic species, of course, varies considerably, and for the sake of clarity, Mr. Risdon has divided the commoner ones into three categories, according to their staple diets. 56 different species are illustrated in colors, thus providing the beginners with a guide for identification.—J. D.

A Guide to Bird Watching.—Joseph J. Hickey (Garden City Books, Garden City, New York.) xiv + 264 pp. Reprint Edition. 1953. $1.98.—That Hickey's valuable book has been reprinted will be good news to ornithologists. (For a review, see the Auk, 61: 151–152, 1944.) The current printing differs from at least three copies of the first in having a different dust jacket, in lacking the figures of bird tracks on the end papers, and in the addition of three pages on "National and Regional Organization Devoted to Ornithology." The latter, however, may have been added at some time during the first printing, as the officers listed for these organizations are out of date by several years.—R. W. S.

The Life of the Robin.—David Lack. (Penguin Books, Baltimore) 240 pp. 1953. $0.65.—Penguin Books are to be congratulated for bringing out a revised edition of this excellent little book at a price which all can afford. For a full review see the Auk, 60: 609–610. 1943.—R. W. S.

ALDRICH, JOHN W. 1953. Habits and habitat differences in two races of Traill's Flycatcher. Wilson Bull., **65** (1): 8–11.—Discusses *Empidonax traillii traillii* and *E. t. campestris* in eastern North America.—J. T. T.

BABERO, B. B. 1952. The experimental infection of Alaskan gulls (*Larus glaucescens*) with *Diphyllobothrium* sp. Journ. Parasit., **38** (4, sect. 2): 23.—Identical plerocercoids from trout developed to maturity in gulls, bears, dogs, foxes, and man.—J. D. W.

BAILY, A. L., and R. P. FOX. 1953. Notes on warblers in Colorado. Wilson Bull., 65 (1): 47.

BAUER, K. 1952. Der Blutspecht (*Dryobates syriacus*) Brutvogel in Österreich. Journ. f. Ornith., **93**: 104–111.—This Asiatic species, which only 25 years ago reached Hungary, has now been nesting regularly in eastern Austria.—E. M.

BAUER, K. 1952. Der Bienenfresser (*Merops apiaster* L.) in Österreich. Journ. f. Ornith., **93**: 290–294.—Bee-eaters have nested regularly in Austria since 1946. They have also expanded their range in Hungary and Czechoslovakia.—E. M.

BAUMEL, JULIAN J. 1953. Individual variation in the white-necked raven. Condor, **55** (1): 26–32.—The paper is concerned with the quantitative aspect of individual variation in 36 skeletal measurements of *Corvus cryptoleucus*. Variability of external measurements was about 3 per cent. Tail length was most variable and extent of wings least variable. Average skeletal variability was about 3.5 per cent, the skull being the least variable. Body weight was more variable than any external or internal linear measurement. No significant differences in variability between sexes were found. A relatively larger pelvis was indicated for females. The modal number of sclerotic plates was 14. In both limb skeletons there was a gradation in variability from least in the proximal elements to greatest in the distal elements.—W. H. B.

BENNETT, HOLLY REED. 1952. Fall migration of birds at Chicago. Wilson Bull., **64** (4): 197–220, 8 tables.—A study of the influence of season, topography, and weather on fall migration. Waves of autumn migrants accompanied or followed the passage of cold fronts.—J. T. T.

BENSON, C. W. 1952. Notes from Nyasaland. Ostrich, **23**: 144–159.—Taxonomic and ecological.

BOURLIÈRE, F. 1952. Des oiseaux sur l'inlandsis groënlandais. Alauda, **20** (3): 179.—*Nyctea scandiaca* at the center of the ice cap (a lost bird).—C. V.

BRACKBILL, HERVEY. 1952. Light intensity and waterfowl flight; pre-flight activities. Wilson Bull., **64** (4): 242–244, 1 table.

BRODKORB, PIERCE. 1953. Pleistocene birds from Haile, Florida. Wilson Bull., **65** (1): 49–50.

BULLOCK, W. L. 1952. Two new species of Monostomes from the Canada Goose with a review of *Paramonostomum alveatum* (Mehlis in Creplin, 1846). Journ. Parasit., **38** (5): 371–378.—New species of *Catatropis* and *Paramonostomum*, from New Hampshire.—J. D. W.

CADE, TOM J. 1953. Sub-nival feeding of the redpoll in interior Alaska: a possible adaptation to the northern winter. Condor, **55** (1): 43–44.—Observations of redpolls feeding on seeds under the snow.—W. H. B.

CADE, TOM J. 1953. Behavior of a young Gyrfalcon. Wilson Bull., **65** (1): 26–31.—Observations on a tame *Falco rusticolus* and its "play," with a brief discussion of play in birds.—J. T. T.

CADE, TOM J. 1953. "Cataleptic" behavior in the Hudsonian Chickadee. Wilson Bull., **65** (1): 45.—Discussion of "cataleptic" behavior in *Parus hudsonicus* and comments on similar behavior recorded for other species of *Parus*.—J. T. T.

CADE, TOM J. 1953. Aerial feeding of the Rusty Blackbird [*Euphagus carolinus*] on mosquitoes. Wilson Bull., **65** (1): 52–53.

CREUTZ, G. 1953. Beeren und Früchte als Vogelnahrung. Beitr. Vogelkunde, **3**: 91–103.—A list of various fruits and berries, particularly of ornamental shrubs, that are eaten by certain species of European birds.—E. M.

CROSSLEY, D. A., JR. 1952. Two new nasal mites from Columbiform birds. Journ. Parasit., **38** (5): 385–390.—New species of *Spleognathus* from the Rock Dove and *Neonyssus* from the Mourning and Mexican Ground doves from Texas.—J. D. W.

DEMANDT, C. 1953. Brutbiologische Probleme beim Wanderfalken (*Falco peregrinus*). Journ. f. Ornith., **94**: 99–102.—Clutch-size in the Rhine region is often only one or two. Two individuals which bred in juvenal plumage did not produce fertile eggs. No second broods were observed when the first brood was destroyed. In the mountains the nests are on cliffs, in the lowlands in trees.—E. M.

DROST, R. 1953. Über die Heimattreue deutscher Seevögel. Journ. f. Ornith., **94**: 181–193.—Records of sea birds recovered in the colonies where they had been hatched, and in other colonies.—E. M.

EISENMANN, EUGENE. 1952. Olivaceous Cormorant. Wilson Bull., **64** (4): 195–196, 1 plate (by George M. Sutton).—A brief description of *Phalacrocorax olivaceus* and its range and habits.—J. T. T.

EMEIS, W. 1953. Von den schleswig-holsteinischen Störchen. Journ. f. Ornith., **94**: 114–116.—The stork population continues to decrease: 2,175 pairs in 1939, 1,002 in 1948, 814 in 1951. 1,901 young (= 3.1 per pair) were raised in 1951.—E. M.

ENGELBACH, P. 1952. Notes de voyage dans les Monts des Cardamomes (Cambodge). L'Oiseau, **22**: 283–302.—A spring trip in the southern Cambodia mountains, species noted.—C. V.

ETCHECOPAR, R. D. 1952. Note sur la nidification de l'Hirondelle Rousseline en Espagne. L'Oiseau, **22**: 319–320.—Apparently the northernmost breeding record of *Hirundo daurica* in Spain (Despeñaperros, Sierra Morena).—C. V.

FARR, M. M. 1952. *Tyzzeria* sp. from wild geese and a wild duck. Journ. Parasit., **38** (4, sect. 2): 15.—This coccidian was common in Canada and Snow geese and was found in a Black Duck, all in North Carolina.—J. D. W.

FENNELL, CHESTER M. 1953. Notes on the birds of Daikokujima, Hokkaido, Japan. CONDOR, **55** (1): 38–42.—Annotated list of 17 species.—W. H. B.

FERRY, C. 1952. Sur la reproduction du Bihoreau en Côte-d'Or. L'Oiseau, **22**: 317–319.—This species (*Nycticorax nycticorax*) is spreading and its population is increasing in France.—C. V.

FRANK, F. 1952. Beobachtungen en einer Nonnensteinschmätzer-Population (*Oenanthe p. pleschanka* [Lepechin]). Journ. f. Ornith., **93**: 138–141.—Notes on territorial requirements and song in this wheatear.—E. M.

GLENNY, FRED H. 1952. The Problem of Specific and Subspecific Status and Morphological Deviation in the Ancient Murrelet *Synthliborhamphus antiquus* (Gmelin). Ohio Journ. Sci., **52** (4): 221–223, 3 figs.—*S. wumizusume* belongs to bicarotidinae normales but of 7 *S. antiquus* studied, 2 were bicarotidinae and 5 were laevocarotidinae, the latter all from "Alaska." The author suggests that the population of the laevocarotidinae type be known as *S. antiquus L*, and the other population as *S. antiquus B* until such time as other characters may be established to justify further separation.

GLENNY, FRED H. 1952. A Systematic Study of the Main Arteries in the Region of the Heart. Aves XVI. Charadriiformes, Part 2. Ohio Journ. Sci., **52** (6):

314–316.—One charadriid, 1 larid, and 5 alcids are all basically bicarotidinae normales.

GLOVER, FRED A. 1953. Nesting ecology of the Pied-billed Grebe [*Podilymbus podiceps*] in northwestern Iowa. Wilson Bull., **65** (1): 32–39, 1 photo, 2 tables.

GOETHE, F. 1953. Experimentelle Brutbeendigung und andere brutethologische Beobachtungen bei Silbermöwen (*Larus a. argentatus* Pontopp.). Journ. f. Ornith., **94:** 160–174.—The calls of the unhatched young, heard through the egg shell, cause a pronounced shift in the behavior of the parents. If fairly fresh eggs are replaced by such pre-hatching eggs, the parents react by many irrelevant actions (preening, calling, etc.) but quickly take care of the hatching young. Details on various phases of the breeding of Herring Gulls are given.—E. M.

GRUBE, G. E. 1953. Black snake captures nestling Blue-winged Warbler [*Vermivora pinus*]. Wilson Bull., **65** (1): 50.

HAND, R. L. 1953. Bird notes from western Montana. Condor, **55** (1): 44–46.—Annotated list of 20 species.—W. H. B.

HAVERSCHMIDT, FR. 1952. More bird weights from Surinam. Wilson Bull., **64** (4): 234–241, 1 table.—Records of the weights of a total of 482 specimens of 186 species, with month, sex, and age noted.—J. T. T.

HAVERSCHMIDT, FR. 1953. Notes on the life history of Columbigallina talpacoti in Surinam. Condor, **55** (1): 21–25.—The Talpacoti Ground Dove breeds throughout most of the year, raising several broods. Data are presented on three broods reared in the same nest. Other topics dealt with pertain to song-courtship flight, copulation, nest building, incubation and growth of young.—W. H. B.

HAVERSCHMIDT, FR. 1953. Wing-flashing of the Graceful Mockingbird, *Mimus gilvus*. Wilson Bull., **65** (1): 52.

HEIM DE BALSAC, H. 1952. Considérations sur une biocénose constituée autour d'un nid de Cigogne *Ciconia ciconia*, en Lorraine. Alauda, **20** (3): 144–155, 1 fig.—An old stork nest, consisting of about 200 pounds of mud and organic material, and its rich animal community is studied. Two species of birds (Kestrel and Tree Sparrow), 31 species of Coleoptera, 1 of Hemiptera, and 1 of Hymenoptera share the nest with the stork.—C. V.

HERMAN, C. M. and L. S. DIAMOND. 1952. Trypanosomes from Canada Geese. Journ. Parasit., **38** (4, sect. 2): 12.

HOESCH, W. 1952. Ornithologische Beobachtungen aus dem Kaoko-Veld in Südwest-Afrika. Journ. f. Ornith., **93:** 115–121, 4 plates.—Description of the birds and mammals encountered in this district of South West Africa.—E. M.

HOESCH, W. 1952. Über die Funktion des phalloiden Organs beim Büffelweber (*Bubalornis albirostris niger*). Journ. f. Ornith., **93:** 362–363.—During copulation the male apparently hooks his curved phalloid organ into that of the female.—E. M.

HOFSTETTER, F. B. 1952. Das Verhalten einer Türkentauben-Population. Journ. f. Ornith., **93:** 295–312.—The recently arrived *Streptopelia decaocto* has already reached a population of 20–30 individuals in the town of Soest. Three broods are raised annually and mortality is very low. The birds are closely associated with human habitations. Call notes, displays, location of nest, and raising of the brood are discussed. A hybrid with the turtle dove (*S. turtur*) was found.—E. M.

HUE, FRANCOIS. 1952. Nouvelles observations sur le Coucou Geai *Clamator glandarius* (L.) en France. L'Oiseau, **22:** 303–316, 1 fig.—A study of some young birds, apparently not of the same age, raised in the same magpie's nest with speculations on the incubation of the magpie which, it is concluded, starts only when the clutch is complete. A few notes on the distribution and migration of *Clamator glandarius* in France.—C. V.

HUNTER, W. S. 1952. Contributions to the morphology and life history of *Gynaecotyla adunca* (Linton, 1905) (Trematoda: Microphallidae). Journ. Parasit. **38** (4, sect. 1): 308–314.—Second intermediate host the fiddler crab. Best final hosts are various charadriiform birds and Seaside Sparrow, but also occurs in various ocean fish.—J. D. W.

HUNTER, WANDA SANBORN, and WINONA B. VERNBERG. 1952. *Leucochloridium beauforti* n. sp. (Trematoda: Brachylaemidae) from the Seaside Sparrow, *Ammospiza maritima macgillivraii* (Audubon). Journ. Parasit., **38** (3): 215–217, 1 fig.

JACOBS, L., M. L. MELTON, and F. E. JONES. 1952. The prevalence of toxoplasmosis in wild pigeons. Journ. Parasit., **38** (5): 457–461.—*Toxoplasma gondii* is fairly common in feral Rock Doves, but the epidemiologic relationship to the disease in man and domestic mammals is not known.—J. D. W.

JENNER, C. E., and W. L. ENGELS. 1952. The significance of the dark period in the photoperiodic response of male Juncos and White-throated Sparrows. Biological Bull., **103** (3): 345–355, 2 figs., 4 tables.—When male *Junco hyemalis* were subjected to 10 hours of light and 14 of darkness for 8 weeks, their testes failed to develop to breeding condition. When other Juncos were subjected to 16 hours of light and 8 of darkness for 8 weeks, their testes developed to breeding condition. Testes of other Juncos, subjected to a cycle of 8¼ hours of light, 7 hours of dark, 1¾ of light, and 7 hours of dark (totalling 10 hours of light and 14 of dark) either developed mature sperm (4 cases) or became slightly enlarged (2 cases). The response of *Zonotrichia albicollis* was similar. There appears to be a dark-period reaction in the development of the breeding condition of these birds.—J. T. T.

JOHANSEN, H. 1952. Die Vogelfauna Westsibiriens, II, 1. Journ. f. Ornith., **92**: 145–204.—A continuation of the discussion of the birds of western Siberia, the present installment containing the Motacillidae, Certhiidae, Paridae, Regulidae, Paradoxornithidae, Laniidae, and Bombycillidae. Data are given on taxonomy, ecology and habits. New subspecies: *Anthus richardi dauricus* (p. 145), *A. r. ussuriensis* (p. 146), *A. campestris kastschenkoi* (p. 147), *A. gustavi commandorensis* (p. 152), *Parus ater rosso-sibiricus* (p. 177), *P. palustris altaicus* (p. 182), *Lanius collurio pallidifrons* (p. 199).—E. M.

JOUANIN, C. 1952. Une invasion de Pétrels cul-blanc. L'Oiseau, **22**: 322–325.—An inland invasion in France of *Oceanodroma leucorhoa* Vieillot following a severe cyclonic storm.—C. V.

JUBB, R. A. 1952. Some Notes on Birds of Southern Rhodesia. Ostrich, **23**: 162–164.—Life history.

JULIEN, M. H. 1952. Avifaune de l'île d'Ouessant. Alauda, **20** (3): 157–170.—List of the pelagic species.—C. V.

KEEGAN, H. L. and R. A. HEDEEN. 1952. Collections of ectoparasitic mites from Alaska. Journ. Parasit., **38** (4, sect. 1): 360–361.—Includes records from swallows' nests.—J. D. W.

KLUZ, ZD. 1951. Zum Problem des Wegtragens der Jungen durch Altvögel bei *Charadrius h. hiaticula* L. Journ. f. Ornith., **93**: 36–38.—No carrying of the young of this plover by the parents was observed at a locality from which another observer had recorded it.—E. M.

KOEHLER, O. 1951. Der Vogelgesang als Vorstufe von Musik und Sprache. Journ. f. Ornith., **93**: 3–20.—Some bird songs appear innate, others are learned. Birds may repeat songs or other sounds a year or more after having first heard them, without uttering them in the meantime. What is truly innate can be determined only by raising birds from the egg in sound-proof rooms. The author points out various parallels between bird sounds and human music and language.—E. M.

KOENIG, O. 1952. Ökologie und Verhalten der Vögel des Neusiedlersee-Schilfgürtels. Journ. f. Ornith., **93:** 207–289.—An analysis of the ecology of the birds living in the vast marshes around this lake on the border of Austria and Hungary. Food, enemies, location of nest, abundance, call notes, and habitats are discussed. The Penduline Tit (*Remiz*) nests in willows and also in Phragmites, as in central Asia. Some marsh harriers (*Circus aeruginosus*) prey on eggs and nestlings of herons and spoonbills and decimate their colonies. Each bird of the area has its well defined niche and is specially adapted for it.—E. M.

KOENIG, OTTO. 1952. Kormoran und Fischerei. Natur und Land, **38** (7/8): 91–92.

KRAMER, G. 1953. Über Wachstum und Entwicklung der Vögel. Journ. f. Ornith., **94:** 194–199.—The various parts of the body, e. g., digestive tract, wings, legs, skeleton, total weight, change unevenly during the development of the young bird. Each deviation from a smooth growth curve has a specific selective significance.—E. M.

KUHK, R. 1953. Lautäusserungen und jahreszeitliche Gesangstätigkeit des Rauhfusskauzes, *Aegolius funereus* (L.). Journ. f. Ornith., **94:** 83–93.—Description of the vocal repertoire of Tengmalm's Owl. The normal song period extends from Christmas to the end of June, with peaks in April and May.—E. M.

KÜHTREIBER, JOSEF. 1952. Die Vogelwelt der Lienzer Gegend. Schlern-Schriften, **98:** 225–243.—A study of the avifauna of Lienz and vicinity in Eastern Tyrol.

KUMERLOEVE, H. 1953. "Verkehrter" Herbstzug über der Insel Amrum. Beitr. Vogelkunde, **3:** 103–106.—Description of a case of reverse migration and of the weather conditions under which it took place.—E. M.

LABITTE, A. 1952. Notes biologiques sur le Pipit des arbres en Pays drouais. L'Oiseau, **22:** 261–282.—A study of the life history of *Anthus trivialis* in central western France.—C. V.

LAFERRÈRE, M. 1952. Passages de Rapaces au printemps dans le Sud-Est. Alauda, **20** (3): 186–188.—Late Spring migration (May 8–20) of hawks in the Rhône Valley.—C. V.

LÖHRL, H. 1951. Balz und Paarbildung beim Halsbandfliegenschnäpper. Journ. f. Ornith., **93:** 41–60.—An excellent detailed study of courtship and pair formation in the Collared Flycatcher (*Muscicapa a. albicollis*). For an abstract see Bird Banding, 1952, vol. 23, no. 2, pp. 85–86.—E. M.

LUGITSCH, RUDOLF. 1952. Der Blutspecht im Neusiedler Seegebiet. Natur und Land, **38** (3/4): 46–47.—*Dryobates syriacus* recorded for the first time in Eastern Austria.

LUGITSCH, RUDOLF. 1952. Einiges aus der Biologischen Station in Neusiedl. Natur und Land, **38** (11/12): 155–156.—*Rissa tridactyla, Otus scops, Aquila pomarina, Clangula hyemalis, Merops apiaster, Dryobates syriacus, Aquila heliaca* occurring in Eastern Austria in the territory of the salt lake near Neusiedl.

MACDONALD, J. D. 1952. Variation in the Capped Wheatear, *Oenanthe pileata*. Ostrich, **23:** 160–161.—*Oenanthe pileata neseri*, subsp. nov., from Erongo Mts., Omaruru Dist., S. W. Africa.

MCINTOSH, A., and M. M. FARR. 1952. *Renicola brantae* n. sp. from the kidney of the Canada Goose, *Branta canadensis* (Linnaeus, 1758). Journ. Parasit., **38** (4, sect. 2): 35–36.

MEHNER, JOHN F. 1952. Turkey Vultures [*Cathartes aura*] attacking Great Blue Heron [*Ardea herodias*]. Wilson Bull., **64** (4): 242.

MEISE, W. 1952. *Zosterops intermedia mentoris* nom. nov. Journ. f. Ornith., **93:** 365.—A new name for *Z. i. erwini* Meise 1941, preoccupied by *Z. palpebrosa erwini* Chasen 1934.—E. M.

MERWALD, FRITZ. 1952. Eine Kormorankolonie bei Linz. Natur und Land, **38** (5/6): 69–70.—A brief study on a colony of *Phalacrocorax carbo* near Linz (Upper Austria).

MILDENBERGER, H. 1953. Zur Fortpflanzungsbiologie des Kampfläufers (*Philomachus pugnax* L.).—Journ. f. Ornith., **94**: 128–143.—The results of the observation of five males and seven females of the Ruff differ in various ways from the classical reports of Selous. Three of the five males had their favorite display stations. Two of the males were "superior" and attracted two females each, one male was essentially monogamous, and two males with a common display ground shared two females. One of the "superior" males copulated also with the otherwise monogamous female. In this small population there were thus monogamy, polygamy, polygyny, and polyandry represented. The females built their nests near the display stations of the males, and the males took a decided interest in the nest sites of the females within their territory. After the hatching of the young the males continued to show interest in the females. The first eggs were laid more than five weeks after the first appearance of the females.—E. M.

MILLER, JEANNE ELIZABETH, and HERBERT L. EASTLICK. 1952. Studies on Transplanted Embryonic Limbs of the Chick. IV. The cytology of the "Adipose Tissue." Trans. Amer. Micros. Soc., **71** (1): 1–19, 25 figs.—Fat cells are specialized active cells and not passive storage cells.

MUMFORD, RUSSELL E. 1952. Bell's Vireo in Indiana. Wilson Bull., **64** (4): 224–233, 1 photo., 1 table.—The records of *Vireo bellii* in Indiana are summarized, and observations of habitat, nesting, and song are recorded.—J. T. T.

MUMFORD, RUSSELL E. 1953. White-rumped Sandpiper in Indiana. Wilson Bull., **65** (1): 44–45.—A summary of records of *Erolia fuscicollis* in Indiana.—J. T. T.

NICE, MARGARET M. 1953. Some experiences in imprinting ducklings. Condor, **55** (1): 33–37.—At the Delta Waterfowl Research Station, Manitoba, studies on newly-hatched ducklings were made in 1951 and 1952. The first year no imprinting occurred but the second year, using Fabricius' technique, 12 ducklings of 5 species were imprinted on human beings.—W. H. B.

OAKESON, BARBARA BLANCHARD. 1953. Cyclic changes in liver and spleen weights in migratory white-crowned sparrows. Condor, **55** (1): 3–16, 3 figs.—A comparison was made of strongly migratory wintering and breeding populations of *Zonotrichia leucophrys gambelii*. The former (September through April) were from Santa Barbara, California, the latter (May through July) were taken at Mountain Village, Alaska. Monthly average liver weights for adult males increased from November through April and dropped sharply in May. Females paralleled males in direction and timing, but not in magnitude, of changes in absolute liver weight. Spleen weights were more variable, but both sexes showed increases in mean spleen weights for certain of the successive periods of the annual cycle.—W. H. B.

PARKES, KENNETH C. 1953. Some bird records of importance from New York. Wilson Bull., **65** (1); 46–47.

PAULIAN, P. 1952. Une capture de *Sterna paradisaea*, Pontoppidan à l'Ile Amsterdam. L'Oiseau, **22**: 320–321.

PEARSON, OLIVER P. 1953. Use of caves by hummingbirds and other species at high altitudes in Peru. Condor, **55** (1): 17–20, 1 fig.—Many small birds nesting under the rigorous climatic conditions of the Andes do so in caves where temperatures are more equable. The principal species discussed is the Estella Hummingbird (*Oreotrochilus estella*).—W. H. B.

PRIEBE, M. D. 1952. Acanthocephalan parasites of waterbirds in Eastern Washington. Trans. Amer. Micr. Soc., **71** (4): 347–349.—Host lists for about eight species of acanthocephalans.—J. D. W.

RADFORD, C. D. 1953. The mites (Acarina: Analgesidae) living on or in the feathers of birds. Parasitology, **42** (3): 199–230.—523 species of quill and feather mites, some of which cause depluming, are listed, with all of their recorded hosts.—J. D. W.

RADFORD, C. D. 1953. Four new species of parasitic mites (Acarina). Parasitology, **42** (3): 239–243.—Includes two new species from the cuckoo *Centropus melanops* from the Philippines.—J. D. W.

RAND, A. L. 1953. Geographical Variation in the Laughing Thrush, *Garrulax affinis*. Nat. Hist. Miscellanea (Chicago), No. 116: 1–6.—An Himalayan species; 6 races recognized, 2 new: *G. a. flemingi*, western Nepal, and *G. a. muliensis*, western China.

RAND, R. W. 1952. Guano Enterprise in South West Africa. Ostrich, **23:** 169–185.

RAY, D. K. 1952. On a New Coccidium, *Eimeria sphenocercae* n. sp., from *Sphenocercus sphenurus* (Kokla Green Pigeon). Journ. Parasit., 38 (6): 546–547.

RICHTER, H. 1952. Der Masseneinfall des Fichtenkreuzschnabels, *Loxia curvirostra* L., in Mitteleuropa in den Jahren 1942/43. Beitr. Vogelkunde, **3:** 20–27.—The Red Crossbill invasion took place in two stages. In 1941 an eastern population invaded West Russia and bred there successfully in 1942. These birds reached western Europe in July, 1942. A second eastern wave from eastern Russia started moving in September and flying past western Russia settled in the same areas as the earlier wave.—E. M.

RICHTER, H. 1953. Zur Lebensweise der Wasseramsel: Der Ortswechsel. Journ. f. Ornith., **94:** 68–82.—Color banding of a population of Water Ouzels (*Cinclus cinclus aquaticus*) in Saxony revealed that most paired individuals stayed on their territories during their lifetime. Some individuals leave their territory in September-October to return again in February-March. Young birds wander widely before pairing. In the area of observation there were twice as many males as females, so that some males did not get paired until their third year.—E. M.

RITTINGHAUS, H. 1953. Adoptionsversuche mit Sand- und Seeregenpfeifern. Journ. f. Ornith., **94:** 144–159.—Knowledge of their own young or of their own parents is not inborn in Ringed and Kentish plovers (*Charadrius hiaticula* and *C. alexandrinus*). Voice and appearance are learned. Even when young plovers were placed under Least Terns (*Sterna albifrons*) a parental bond was established in spite of the impossibility of feeding. Reacting to the voice of their own species seems inborn to some extent and has to be replaced by learning.—E. M.

ROBINSON, H. W. 1952. A preliminary report on the life cycle of *Cloacitrema michiganensis* McIntosh, 1938 (Trematoda). Journ. Parasit., **38** (4, sect. 1): 368.—Intermediate host is a marine snail, definitive host various charadriiform birds.—J. D. W.

SAPIN-JALOUSTRÉ, J. 1952. Découverte et description de la Rookery de Manchot Empereur (*Aptenodytes forsteri*) de Pointe Géologie (Terre Adélie), conclusion. L'Oiseau, **22:** 225–260, pls. 11–16.—The conclusion of a detailed study on the morphology, ecology, food, social life, and life cycle of a very interesting species which, thanks to its perfect adaptation and social organization, occupies successfully a niche at the extreme possible limits of homeothermal life. The plates, consisting of 14 photographs, one of them a splendid one in color, illustrate different

phases of behavior including the feeding of the young. A very complete bibliography of 132 titles is given.—C. V.

SCHÄFER, E. 1952. Ökologischer Querschnitt durch den "Parque Nacional de Aragua." Journ. f. Ornith., **93**: 313–352, 10 plates.—A description of the various habitats of the coastal cordillera of Venezuela and of its inhabitants. Details of the life history of the Bell Bird (*Procnias averano*).—E. M.

SCHIERER, A. 1952. Les Cigognes en Alsace. Résultats des recensements des années 1950 et 1951. Alauda, **20** (3): 129–143, 5 graphs.

SCHMIDT, W. J. 1952. Neuere Untersuchungen über Schillerfarben. Journ. f. Ornith., **93**: 130–135.—The iridescence of glossy feathers originates at the surface of melanin granules and is not caused by keratin lamellae, as stated in the earlier literature.—E. M.

SCHNEIDER, K. M. 1953. Einiges von gefangen gehaltenen Seetauchern (*Colymbus* L.). [= *Gavia*]. Beitr. Vogelkunde, **3**: 63–91.—Observations on loons kept in captivity; discusses their food intake, swimming and diving, preening, and diseases.—E. M.

SCHNEIDER, W. 1952. Beitrag zur Lebensgeschichte des Stars, *Sturnus v. vulgaris* L. Beitr. Vogelkunde, **3**: 27–52.—Based on 25 years of observation of a starling colony, in which 950 breeding adults and 1350 of their young were banded. Data on migration, returns, and broods. About 50 per cent of the females have a second brood, often in the same nest box. No second broods in certain years. Average May clutches 5.7 eggs, June 4.1 eggs. Successful broods in May had 4.6 fledglings, in June 3.3 fledglings.—E. M.

SCHNURRE, O. 1953. Über einige Bestandsveränderungen märkischer Raubvögel. Journ. f. Ornith., **94**: 94–98.—The Peregrine Falcons are decreasing, Goshawks and Sea Eagles increasing. Gunners and game keepers are the most serious enemies of the larger birds of prey. The Coot (*Fulica atra*) is the staple food of the Sea Eagle, and pigeons (during the breeding season) that of the Peregrine Falcon.—E. M.

SCHÖNWETTER, M. 1952. Die Schalendicke bei Zwerg- und Rieseneiern. Journ. f. Ornith., **94**: 175–180.—The thickness of the shell in dwarf and giant eggs of a species fluctuates around the same mean as that of normal eggs.—E. M.

SCHÜZ, E. 1953. Schlussbericht (1944) über die Starsiedlung in Rossitten. Journ. f. Ornith., **94**: 31–35.—Concluding report on seasonal and other biological phenomena of a starling colony at Rossitten.—E. M.

SCHWARTZ, C. W., and E. R. SCHWARTZ. 1953. Notes on the Hawaiian Duck. Wilson Bull., **65** (1): 18–25, 5 photos.—Notes on the abundance and habits of *Anas platyrhynchos wyvilliana*, now threatened with extinction.—J. T. T.

SCHWARTZKOPFF, J. 1952. Über den Gehörsinn der Vögel. Journ. f. Ornith., **93**: 91–103.—Data on various aspects of the acoustics of hearing in birds, the sensitivity of their hearing, and the function and efficiency of middle and inner ear.—E. M.

VON SCHWEPPENBURG, H. G. 1951. Zahmheit bei Vögeln. Journ. f. Ornith., **93**: 32–35.—Tameness in gallinules and ducks is acquired; the young of tame parents are shy. Discussion of attraction of robins for large animals.—E. M.

VON SCHWEPPENBURG, H. G. 1953. Zum Reihen der Enten. Journ. f. Ornith., **94**: 117–127.—The courtship displays of ducks normally take place on the water. If a duck is pursued in flight by one or several drakes, it can mean one of four things: (1) a shift of location, particularly during migration, usually preceded and followed by a swim display; (2) nuptial courtship: a drake pursuing his mate in a

courtship flight; (3) territorial chase: a territory-holding drake pursuing the duck of an invading pair with her drake following; (4) pursuit chases of a duck by several drakes. The author is of the opinion that these pursuit chases are neither territorial chases nor courtship flights, but attempts of the males to rape the females. He seems to be unaware of the frequency of pursuit flight in the courtship of many passerine birds.—E. Mayr.

SKEAD, C. J. 1952. The Status of the Cattle Egret, *Ardeola ibis*, in the Eastern Cape Province. Ostrich, **23:** 186–218.—Discusses range expansion of the Cattle Egret in Africa and mentions possible correlation with its invasion of America.

SICK, H. 1951. Umstellung der Nistweise beim Stachelschwanz-Segler (*Chaetura andrei*). Journ. f. Ornith., **93:** 38–41.—This swift, which normally nests in hollow palms, was found nesting in chimneys in several Brazilian towns.—E. M.

STEIN, G. H. W. 1952. Probleme der Ökologie und der Siedlungsdichte bei der Misteldrossel, *Turdus viscivorus* L. Journ. f. Ornith., **93:** 158–171.—Analysis of the ecological differences between various populations of the Mistle Thrush and of the reasons for the rapid expansion of this species in northwestern Europe.—E. M.

STEVENSON, JAMES O. 1953. Bird notes from the Texas coast. Wilson Bull., **65** (1): 42–43.

STEYN, P. B. 1952. The Nesting of the African Great Swift, *Apus melba africanus*. Ostrich, **23:** 221–222.—Nests composed of "chewed up" feathers mixed with saliva.—D. A.

STRESEMANN, E. 1951. Weiteres Vordringen der Türkentaube. Journ. f. Ornith., **93:** 26–31.—The rapid increase and spread of *Streptopelia decaocto* continues.—E. M.

STUNKARD, H. W. and M. C. HINCHLIFFE. 1952. The morphology and life history of *Microbilharzia variglandis* (Miller and Northrup, 1926) Stunkard and Hinchliffe, 1951, avian blood flukes whose larvae cause "Swimmers' itch" of ocean beaches. Journ. Parasit., **38** (3): 248–265.—Intermediate host is a mud snail; final host is the Lesser Scaup and probably other migratory ducks and shore birds.—J. D. W.

SUTTON, GEORGE MIKSCH. 1952. New birds for the State of Michoacan, Mexico. Wilson Bull., **64** (4): 221–223.—Seven species believed to be reported for the first time from this area.—J. T. T.

SUTTON, GEORGE MIKSCH. 1953. Gray Hawk. Wilson Bull., **65** (1): 5–7, 1 plate.—A brief description of *Buteo nitidus*, its range and habits.—J. T. T.

THOMSEN, P., and E. STRESEMANN. 1953. Briefe, gewechselt in den Jahren 1818 bis 1820 zwischen Heinrich Boie und Johann Friedrich Naumann. Journ. f. Ornith., **94:** 7–30.—An interesting exchange of letters between two great ornithologists, giving an intimate picture of the personalities and current problems of that period.—E. M.

TORDOFF, HARRISON B. 1953. Irazu Junco [*Junco vulcani*]—a primitive member of the genus. Wilson Bull., **65** (1): 51.

WADE, DOUGLAS E. 1952. Mortality of migrating birds at Mt. Washington, New Hampshire. Wilson Bull., **64** (4): 242.—Eleven individuals of 5 species apparently killed by downdraft winds.—J. T. T.

WADEWITZ, O. 1952. Ein Beitrag zur Biologie des Flussuferläufers, *Actitis hypoleucos* (L.). Beitr. Vogelkunde, **3:** 1–20.—Differences between male and female in parental care. Call notes, nest sites, incubation.—E. M.

WALLRAFF, H. G. 1953. Beobachtungen zur Brutbiologie des Stares (*Sturnus v. vulgaris* L.) in Nürnberg. Journ. f. Ornith., **94:** 36–67.—A very detailed report of observations made on 5 starling nests during four years. Roosting, pre-pairing

activities, territory, pair-formation, sex-ratio, polygamy, nest-building, egg-laying, eggs, incubation, hatching, fledging, and second broods are described and quantitatively documented, as is the participation of the male in incubation and feeding. Such detailed studies in different parts of the world are necessary to give us information on the amount of individual and geographic variation in the biology of a single species.—E. M.

WEHR, E. E. 1952. *Dermoglyphus elongatus* (Megnin, 1877), a quill mite of the house canary in the United States. Journ. Parasit., **38** (6): 548–549.—The mites lived in developing pinfeathers and caused serious depluming.—J. D. W.

WENDLAND, V. 1952. Populationsstudien an Raubvögeln. I. Zur Vermehrung des Mäusebussards (*Buteo b. buteo* (L.)). Journ. f. Ornith., **93**: 144–153.—Of 170 broods of buzzards studied over a number of years, 31 per cent were destroyed, mostly through human interference. On the average, a pair raises 1.4 young. In the year of a vole plague the average was 2.6 young, in two other mouse years 1.77 and 1.52. In extensive pine-forests other animals, such as birds, reptiles, and frogs, are important food.—E. M.

WENDLAND, V. 1953. Populationsstudien an Raubvögeln: Bruterfolg 1940–1951, untersucht bei 7 Arten. Journ. f. Ornith., **94**: 103–113.—331 pairs of seven species of birds of prey were studied in the years 1940 to 1951. The percentage of destroyed broods ranged from 28 (Goshawk) to 76 (Peregrine Falcon). Chief causes of destruction were man (Peregrine, Goshawk, Buzzard), crows (Kite, Hobby) and other hawks (Kestrel). The number of young raised per pair ranged from .47 (Peregrine) to 1.9 (Kestrel). The mouse-eating species (Buzzard, Kestrel) may have high mortality in the nest when mice are scarce. Population numbers remained static for most species. Goshawks increased after shooting terminated in 1945, Peregrines decreased when pigeons became scarce in the same year.—E. M.

VÖLKER, O. 1951. Die Isolierung eines gelben und eines roten Lipochroms aus Vogelfedern. Journ. f. Ornith., **93**: 20–26.—The author succeeded in extracting pure carotinoids from bird feathers. He proved, by analysis of the crystals, that the yellow pigment of an African oriole (*Oriolus*) is lutein, and that the red pigment of an African shrike (*Laniarius*) is astaxanthin. Surprisingly, the red pigment of a flamingo (*Phoenicopterus*) and of a Scarlet Ibis (*Guara rubra*) is not astaxanthin. —E. M.

VÖLKER, O. 1952. Die Lipochrome in den Federn der Cotingiden. Journ. f. Ornith., **93**: 122–129.—Various carotinoids occur in the Cotingidae: lutein in *Ampelion cucullatus*, zeaxanthin in *Rupicola p. peruviana*, and rhodoxanthin in *Phoenicircus nigricollis*. There is no evidence for a special class of pigments, formerly referred to as cotingin. Purplish, dark red, and violet colors of cotingids turn into yellowish red with pressure on the feathers. They have all the characteristics of mixtures of carotinoids, the color of which is modified by structural elements of the feathers.—E. M.

OBITUARIES

EDWARD MATTHEWS BALL, an Associate of the American Ornithologists' Union, elected in 1918, died in Washington, D. C., November 30, 1935, at the age of 69. He was born in Loudoun County, Virginia, April 18, 1876, and was an employee of the Bureau of Fisheries in Washington, where he was engaged in rearing fish. Although a member of the Union, apparently he published little or nothing on birds.—T. S. PALMER.

LOUIS WILHELM DORN, an Associate of the American Ornithologists' Union, died at Fort Wayne, Indiana, April 4, 1918, at the age of 54. He was born in Boeuf Creek, Missouri, October 15, 1863, and was a professor at the Concordia College, Fort Wayne, Indiana. He was elected an Associate of the A.O.U. in 1912, but during the period of his membership published little, if anything, on birds.—T. S. PALMER.

WILLIAM WRIGHT GRANT, an Associate of the American Ornithologists' Union, elected in 1910, died in Geneva, New York, October 25, 1942, at the age of sixty. He was born in Kingston, Ontario, in 1862 and later lived at Maplewood, New Jersey, The last twenty-three years of his life were spent at Geneva, New York, where he was assessor from 1925 to 1931.

Grant was much interested in birds and especially in their protection. He was the author of a vest-pocket handbook of common birds. For a number of years he was a director of the National Association of Audubon Societies and a great admirer of William Dutcher.—T. S. PALMER.

MRS. CHARLES WOODBURY MELCHER (CATHERINE MITCHELL), an Associate of the American Ornithologists' Union, died at Homosassa Springs, Florida, in December 1941 at the age of 67. She was born in Meriden, Connecticut, December 17, 1874, and was elected an Associate of the Union in 1922. At the time of the A.O.U. meeting in Illinois in 1934 she was living in Riverdale, not far from Chicago, and published a list of birds of the Chicago region. The following year she married Charles Woodbury Melcher and moved to Homosassa Springs, Florida, which was her home for the remainder of her life.—T. S. PALMER.

WILLIAM GARRETT MOORE, an Associate of the American Ornithologists' Union, elected in 1937, died in Haddonfield, New Jersey, May 17, 1944, at the age of 70. He was born in Haddonfield, January 8, 1874, and lived there all his life. He was educated in the public schools and graduated from the University of Pennsylvania in the class of 1894. Moore was a financier with varied activities. He was interested in music, was president of the Orpheus Club, and sang tenor in the quartet of the First Presbyterian Church of Haddonfield for more than 36 years. He was also a member of the Union League of Philadelphia and a founder of the County Y. M. C. A. of Camden County, New Jersey.—T. S. PALMER.

ORD MYERS, an Associate of the American Ornithologists' Union, died at his home in Dayton, Ohio, January 11, 1933, at the age of 63. He was survived by his wife, Mary C. Myers, and his son, Alfred O. Myers. He was born in 1870 and was elected an Associate of the Union in 1917. Notwithstanding his interest in ornithology, he apparently published nothing on birds during the period of his membership in the Union. This is perhaps not surprising on account of his advanced age at the time of his election.—T. S. PALMER.

GEORGE PARMLY, of Orange, New Jersey, an Associate of the American Ornithologists' Union, died October 19, 1947. He was elected an Associate of the Union in 1945. The period of his membership lasted less than two years, and during this time he apparently published nothing on birds.—T. S. PALMER.

NELS THEODORE PETERSON, of Battle Creek, Michigan, was an Associate of the American Ornithologists' Union since 1931. He died March 26, 1948. He was born January 2, 1878, at Rumford, Rhode Island. His parents were Peter and Berta (Larsson) Peterson, natives of Sweden. His work at Providence, after completing High School, was with a wholesale jewelry firm, Blanchard Young and Co. He and Stella Nickerson were married on October 17, 1900. Mrs. Peterson had a hobby of botany and roamed all over New England in her studies. Later she became interested in birds and began to study them as enthusiastically as she had botany. Mr. Peterson's health failed him so that in 1916 they went to Battle Creek to the Sanitarium. As his health improved he and Mrs. Peterson roamed the parks studying birds, and he became as interested as she. In later years he was in charge of the Men's Outdoor Gymnasium at the Sanitarium so that they had much spare time to travel. They made trips almost annually to New England, others to Florida, Texas, the west coast, and the Great Plains States studying birds. Mrs. Peterson died September 6, 1947. After her death Mr. Peterson lacked the usual enthusiasm and soon joined her. She kept daily records of birds and entered all birds observed in her yearly diaries.—L. H. WALKINSHAW.

EUGENE ROCKWELL PIKE, of Chicago, Illinois, an Associate of the American Ornithologists' Union, died January 5, 1946. He was elected an Associate of the Union in 1926, and during the 20 years of his membership published three brief notes in 'The Auk.' Two of these, "Roseate Spoonbill in Florida" (January, 1929) and "Notes on Bird Life in Southern Florida" (1937) were based on his observations in that state during a trip in that year; the third, a record of the occurrence of the Turkey Vulture (*Cathartes aura septentrionalis*) at Chicago on June 21, 1933.—T. S. PALMER.

FRANK OTIS PILLSBURY, an Associate of the American Ornithologists' Union, died at Walpole, Massachusetts, August 6, 1927, at the age of 74. He was born in Newburyport, Mass., March 27, 1853, and was elected an Associate of the Union in 1917. Notwithstanding his interest in birds, apparently he published no ornithological notes. This is not surprising when it is recalled that at the time of his election to the Union he had already passed his sixty-fourth birthday.—T. S. PALMER.

MARCUS CHARLES RICH, an Associate of the American Ornithologists' Union, died in New York City, on November 12, 1941. He was born on September 14, 1881, was educated as a chemist, and later entered the security brokerage business. His wife, Mrs. Eva Rich, had long been a bird watcher, and when he finally was won over, Marc Rich became an ardent student. He was elected an Associate of the Union in 1931, and in 1933, he published three brief notes in 'The Auk' on "Brunnich's Murre on Staten Island, New York," "Great Crested Flycatcher in New Jersey," and "Late Migrations of Fox Sparrows."

His chief interest was the avifauna of the New York City region, particularly that ever-fruitful source of migration data, Central Park. He was instrumental in having a section of the Park fenced off and maintained for a time as an experimental bird sanctuary. For years he was the unofficial compiler of Central Park records and would regularly report the migration results at meetings of the Linnaean Society of New York. Of necessity, in an area so attractive to the novice, Marc Rich had to exercise a fine discrimination in winnowing out questionable reports. Acceptance by him of an *uncorroborated* Central Park observation as to an unusual bird or date was truly recognition that one had achieved the status of a competent local birder.

He and his wife were particularly encouraging to the younger students, who were always sure of getting a "hitch" in his car if they met Marc Rich afield. His passing was a great loss to his many friends in and out of the Linnaean Society.—E. EISENMANN.

CLARK PERKINS STREATOR, an Honorary Life Associate of the American Ornithologists' Union and an honorary member of the Cooper Ornithological Society, died at Santa Cruz, California, November 28, 1952, at the age of eighty-four. Streator was born in Ohio in 1866 and was elected an Associate of the Union in 1889. Forty years afterwards, he became automatically an Honorary Life Associate.

In the early 80's, Streator traveled extensively in the West Indies collecting birds for Charles B. Cory. About 1890, he collected in British Columbia for the American Museum of Natural History in New York, and in later years in various parts of the West and in Mexico for the Biological Survey of the Department of Agriculture.

Streator was much interested in the mammals of California and had visited the type localities of most of the species. His knowledge of these type localities was unrivalled, and years afterwards he could recall with considerable detail not only the location but the topographical features of these places.

His publications included a few notes in 'The Young Oölogist' and in later years a mimeographed, annotated list of the birds of Santa Cruz County, containing the results of his observations extending over a long period of time.

For some years Streator was associated with welfare work in Santa Cruz.

He was married and had one son. His wife was killed in an accident near San Luis Obispo some years ago.—T. S. PALMER.

REVEREND GORDON BOIT WELLMAN, an associate of the American Ornithologists' Union, died at Wellesley, Massachusetts, March 30, 1942. He was Associate Professor of Biblical History at Wellesley College and was associated with Wellesley from 1919 until his death. He was elected an Associate of the Union in 1908 and maintained his membership for over 30 years. He contributed several brief notes to The Auk, including "Dance of Purple Finch" (1920), "The Courtship Flight of the Red-breasted Nuthatch" (1933) and "Chickadee neurasthenia" (1938).—T. S. PALMER.

WILLIAM AUGUSTUS WHITE, an Associate of the American Ornithologists' Union, elected in 1902, died of heart disease in Brooklyn, New York, May 14, 1927, at the age of 83. He was the son of Alexander Moss and Elizabeth Treadway White and was born in Brooklyn in 1844. He attended the Brooklyn Collegiate Institute and graduated from Harvard College in 1863. In 1926 he received the honorary degree of LL.D. from Princeton. He was the senior member of W. A. and A. M. White of Wall Street, New York City, and vice president and chairman of the finance committee of the Washington Water Power Company of Spokane, Washington.

Mr. White was noted for his unique collection of Shakespeare and other Elizabethan poets and dramatists, and collaborated with the librarian of the University of Liverpool in publishing an edition of Blake's poetry.

He was much interested in the Brooklyn Polytechnic Institute and the Brooklyn Institute of Arts and Sciences and gave the Brooklyn Public Library a collection of opera scores and librettos. His chief recreation was a love of the woods, and he spent nearly 50 summers at St. Huberts in the Adirondacks. He was survived by his wife and four married children.—T. S. PALMER.

HAL H. HARRISON

Author-photographer-lecturer Hal Harrison is one of the most widely-read wildlife experts in the U. S. His pictures and stories have appeared in Life, Saturday Evening Post, Collier's, National Geographic *and dozens of other well-known magazines. His excellent wildlife motion pictures in natural color, in which he does the narrating have been viewed by thousands. Mr. Harrison lives with his wife and two teen-age daughters in Tarentum, Pa., where he is wildlife editor of the Pittsburgh* Post-Gazette.

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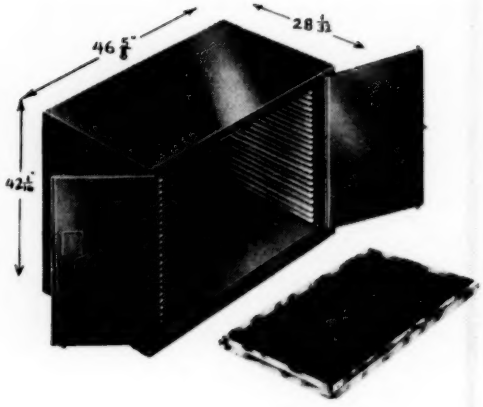

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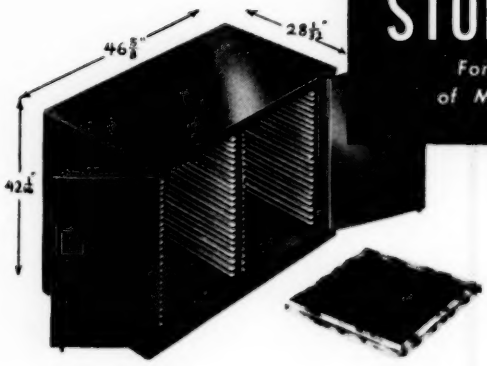

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